

From DEPARTMENT OF WOMEN'S AND CHILDREN'S HEALTH  
Karolinska Institutet, Stockholm, Sweden

# **PRACTICES THAT FACILITATE OR HINDER BREASTFEEDING**

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### *Warm Chain for Breastfeeding*

*“Immunization is preventive medicine par excellence. If a new vaccine became available that could prevent 1 million or more child deaths a year, and that was moreover cheap, safe, administered orally, and required no cold chain, it would become an immediate public health imperative. Breastfeeding could do all this and more, but requires its own “warm chain” of support that is, skilled care for mothers to build their confidence and show them what to do, and protection from harmful practices. If this warm chain has been lost from culture, or is faulty, then it must be made good by health services.”*

*Editorial, The Lancet 1994*

## ABSTRACT

**The overall aim** of this thesis was to address delivery and maternity practices that can impede breastfeeding and to develop methods to facilitate breastfeeding.

**The specific aims** were to study 1) breastfeeding hormones in mothers giving birth vaginally and by cesarean section, 2) to what extent mothers roomed- in with their infants at the maternity and what were their attitudes 3) if anti-secretory factor (AF), known to prevent mastitis in animals, could be induced in human milk 4) if latching-on problems in “older” infants could be remediated by skin-to-skin contact with the mother during breastfeeding.

### **Results and methods:**

*Study I;* During a breastfeed on the second day blood samples were taken from 20 mothers with normal vaginal delivery (VD) and from 17 mothers with emergency cesarean section (CS) for analyses of oxytocin, prolactin and cortisol. The VD mothers had significantly more oxytocin pulses than the CS mothers. Furthermore, CS mothers did not exhibit a rise in prolactin. Mode of delivery, age of infant at first suckling and maternal somatic anxiety were found to affect the number of oxytocin pulses.

*Study II;* One hundred and eleven mothers answered a questionnaire on the current (1990) maternity practices of keeping the infant in their room during the night (NRI) or not. Mothers who left their babies in the nursery at night were more likely to perceive that staff really believed their babies should be there. However, mothers not rooming-in with their babies scored closeness to their babies as less important than mothers who roomed-in with their babies.

*Study III;* Forty mothers were randomly assigned to eat AF inducing cereals (experimental group) or cereals without AF inducing properties (control group). After 4-5-weeks AF was tested in mothers' milk. A biological test was used. The median AF level in the experimental group (n=12) and the control group (n= 16) differed significantly: 1.1 (0.7-1.25) units vs. 0.1(0.0-0.5) units ( $p=0.0001$ ). The frequency of mastitis was reduced in the experimental group compared to the control group ( $p\text{-value}=0.0086$ ). AF levels differed significantly between mothers with and without mastitis ( $p=0.017$ ).

*Study IV:* One hundred and three mother-infant pairs with latching-on problems were randomly assigned to skin-to-skin contact (experimental group) or no skin-to-skin contact during breastfeeding (control group). Mothers in the experimental group showed significantly more positive feelings towards breastfeeding than mothers in the control group. About the same percentage of infants in both groups started to latch on. However, infants in the experimental group (n=31) began to latch on in a significantly shorter median time than infants in the control group (n=33) that is 2 weeks vs. 4.7 weeks (p-value =0.02). Most of the infants (94%) in the experimental group who began to suckle within 3 weeks had a history of “strong reaction” when “helped” to the breast by the staff with “hands-on latch intervention;” corresponding figures for the control group was 33% (p=0.0001).

**Conclusions:** It is hypothesized that early suckling, within 2 hours after birth may be the main catalyst for inducing early oxytocin pulsatility. Healthy infants should have the possibility to stay skin-to-skin with the mother the first hours after birth, so that they go through the biological program to develop breastfeeding reflexes and start suckling when ready. Infants with latch-problems are often caused by forceful “hands-on latch intervention” by staff. However, breastfeeding reflexes may be restored even if the infant is several weeks old, if skin-to-skin contact during breastfeeding with the mother is initiated. Skin-to-skin contact seems to relax the mother as well as the baby. Further, new mothers are often influenced by staff’s more or less explicit attitudes regarding expected maternal behaviors in respect to certain hospital practices such as rooming-in. Women with repeated incidence of mastitis might benefit from consuming cereal with AF inducing properties to prevent the reoccurrence of mastitis.

Key words: anti-secretory factor, attitude scale, breastfeeding, breastfeeding emotional scale, cesarean section, cortisol, early suckling, latch-on problem, mastitis, night rooming-in, oxytocin pulses, prolactin, skin-to-skin contact.

## LIST OF PUBLICATIONS

This thesis is based on the following articles, which will be referred to by their Roman numerals:

- I. Nissen E, Uvnäs Moberg K, Svensson K, Stock S, Widström A-M, Winberg J. Different patterns of oxytocin, prolactin but no cortisol release during breastfeeding in women delivered by caesarean section or by the vaginal route. *Early Human Development*. 1996; 45:103-118.
- II. Svensson K, Matthiesen A-S, Widström A-M. Night rooming-in: who decides? An example of staff influence on mother's attitude. *Birth*. 2005;32:99-106.
- III. Svensson K, Lange S, Lönnroth I, Widström A-M, Hanson LÅ. Induction of anti-secretory factor in human milk may prevent mastitis. *Acta Paediatr*. 2004;93:1229-1231.
- IV. Svensson K, Velandia M, Welles-Nyström B, Widström A-M. Effects of maternal-infant skin-to-skin contact on major infant latch-on problems during the first months after birth. Submitted 2010.

# CONTENTS

1	INTRODUCTION .....	1
1.1	Factors influencing breastfeeding .....	1
1.1.1	Breastfeeding in a global perspective .....	1
1.1.2	Factors related to socioeconomic status and mothers' situations .....	2
1.1.3	Factors related to self esteem, depression and partner support .....	3
1.1.4	Factors related to mothers personality, knowledge, attitudes .....	3
1.1.5	Economic perspectives .....	4
1.1.6	Factors related to hospital staff .....	4
1.1.7	Factors related to hospital practices .....	5
1.1.8	Cesarean section birth .....	6
1.1.9	Hormonal changes during breastfeeding .....	7
1.2	Swedish context of breastfeeding .....	9
1.2.1	The Swedish practice rooming-in .....	10
1.3	Natural infant breastfeeding behavior .....	12
1.4	Benefits of breast milk and breastfeeding .....	13
1.5	Skin-to-skin contact .....	14
1.6	Some practices which facilitate or hinder breast feeding .....	16
1.6.1	Breastfeeding problems .....	16
1.6.2	Anti - secretory factor .....	18
1.7	The Focus of This Thesis .....	19
2	AIM .....	21
3	MATERIAL AND METHODS .....	22
3.1	Setting .....	22
3.2	Study Overview .....	24
3.3	Data collection and methods .....	25
3.4	Recruitment of sample, inclusion criteria, procedures, drop outs .....	27
3.5	STUDY I .....	27
3.5.1	Recruitment of sample .....	27
3.5.2	Procedure .....	28
3.6	STUDY II .....	29
3.6.1	Recruitment of sample and inclusion criteria .....	29
3.6.2	Procedure .....	30
3.7	STUDY III .....	30
3.7.1	Recruitment of sample .....	30
3.7.2	Inclusion criteria .....	31
3.7.3	Procedure and data collection methods .....	31
3.8	STUDY IV .....	32
3.8.1	Recruitment and Inclusion Criteria .....	32
3.8.2	Procedure .....	33
3.9	Statistical analysis .....	38

4	RESULTS .....	40
4.1	STUDY I.....	40
4.1.1	Hormone levels and breastfeeding practices .....	40
4.2	STUDY II.....	42
4.2.1	Mother's perceived staff attitude to night rooming-in .....	42
4.3	STUDY III. ....	45
4.3.1	Content of AF in milk samples .....	45
4.4	STUDY IV.....	46
4.4.2	Effects in relation to the intervention.....	47
4.4.3	Four months after inclusion .....	49
5	DISCUSSION.....	51
5.1	Main results in this thesis .....	51
5.2	Methodological considerations .....	51
5.3	Discussion of results .....	54
6	IMPLICATIONS FOR FUTURE CLINICAL PRACTICES .....	62
7	ABSTRACT IN SWEDISH - SVENSK SAMMANFATTNING .....	63
8	ACKNOWLEDGMENTS .....	65
9	REFERENCES .....	69
	PAPERS I-IV	



## LIST OF ABBREVIATIONS

BFHI	Baby-Friendly Hospital Initiative
WHO	World Health Organization
UNICEF	The United Nations Children's Fund
KSP	The Karolinska Scales of Personality
AF	Anti-secretory factor
HPC	Hydrothermal process cereal
SPC	Special proceed cereal
EDA	Epidural anaesthesia

### Relevant terms and definitions

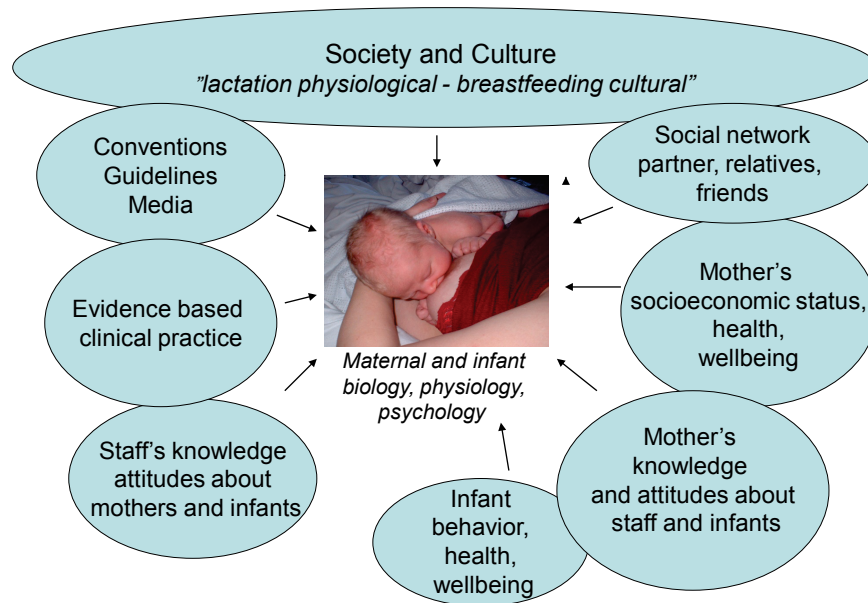
Variables	Definition of variables
Breast inflammation/ Mastitis	When a breast has one or many resistances, localized redness, swelling, pain and, in addition, influenza-like symptoms with or without fever.
Delayed first suckling	First suckling attempt > 2 hours after birth
Exclusive breastfeeding	The infant received nothing but milk from the breast, vitamin D and eventual medication
Hands-on latch intervention	Hospital staff, another person or relative uses their own hands to try to attach the infant to the breast with a grip around the infant's neck and a grip around the mother's breast/nipple sometimes using more or less force.
Latch-on occasionally	Defined in this study as latching but no suckling <i>or</i> as latching and suckling just a few (1-4) times during 1-10 minutes. No regular suckling was established.
Latch-on regularly	The mother perceives that the infant wants to breastfeed; the infant responds by latching-on the breast when it is offered.
Nipple shield	Small plastic or rubber device shaped like the nipple that is placed over the nipple before latching.
No separation	Mother and infant had contact directly after birth and stayed with the mother up to one hour or more.
Partial breastfeeding	Breastfeeding occurs regularly but the infant was also given supplementation or had started to eat solid food
Skin-to-skin contact	Naked skin contact between the mother and infant, except that the infant could wear a diaper



# 1 INTRODUCTION

## 1.1 FACTORS INFLUENCING BREASTFEEDING

Breastfeeding is a complex and multi-factorial phenomenon influenced by demographic, physical, social, and psychological variables (Thulier and Mercer 2009)



**Figure 1:** Some cultural, social, biological and behavioral factors that influence breastfeeding for mothers and infants. (Arrows show the overall influence of society on breastfeeding).

### 1.1.1 Breastfeeding in a global perspective

Breastfeeding is a behavior and practice occurring in all human societies. Although the practice is universal, there are many cultural variations in respect to the onstart of the practice and its duration, as well as the body position taken by the woman and her infant, to name just a few important differences. Also of importance are the culture specific attitudes and the meaning of breastfeeding across societies. Among modern western societies, the variation of breastfeeding practices and their psycho-social meaning tells us something about the value each society places on the infant, ideas about the breast and breast milk (Mead and Newton 1967, Dettwyler 1987). For instance in Sweden many mothers breastfeed both day and night for the first 6 months after birth. At the same time, co-sleeping among Swedish parents has also become common. Parents and children, even babies, sharing a bed at night has been the focus of

several interesting studies tying breastfeeding and co-sleeping together (Welles-Nystrom 2005, Hörnell et al. 1999)

Since breastfeeding is a universal behavior and since almost all populations of women are capable of breastfeeding, it is important to consider how, the practice is formed and transmitted through culture. Many factors in society influence breastfeeding practices. For instance, the anthropologist Margaret Mead's more cited work (Mead and Newton 1969) states that the exaggerated focus on the amount of breast milk produced during the nursing of the infant was one of the most harmful ideas that Western society has passed on to other societies. Not only has it caused women in traditional societies to give up breastfeeding, it has also implicitly supported the idea that babies only need to breastfeed for nutritional gains, according to Mead. She describes breastfeeding as a unique communication and interaction between mother and infant, one that has existed through time. Mothers in many traditional societies give their infants the breast without thought, nor do they worry about when the baby ate last or if their breasts are full or empty. Breastfeeding is a way to insure that the child survives, and is secure. If the baby cries, is afraid, or has hurt itself, she gives the child her breast. In that way, the baby also gets the nutritional value of breast milk in addition to comfort (Mead and Newton 1969).

Margaret Mead also describes the impact of the development concerning breastfeeding in the Western societies, especially during the 20:th century. She points out how the major focus has been on nutrition and regulated "meals": The mother can decide that the baby has had enough to eat. For the infant, this may result in the baby not receiving satisfaction or comfort from the breast, Mead argues. It is the woman who decides when to breastfeed; it is not the infant who signals that it is time for the breast and comfort. Thus, this natural interaction of breastfeeding between infant and mother in traditional societies that used to be constant and taken for granted, in the West became a practice regulated by hospitals, doctors and "medical science." (Mead and Newton, 1969) In fact, the development and use of infant formula was spread around the world as one result of modern technology.

### **1.1.2 Factors related to socioeconomic status and mothers' situations**

There are numerous factors potentially associated with maternal breastfeeding which comprise the cultural model of the practice in historical as well as contemporary time.

Some of this would include maternal socioeconomic background, maternal smoking habits (Taveras et al 2003, Kronborg and Vaeth 2004, Ludvigson and Ludvigsson 2005, Flacking et al 2007, Kristiansen et al. 2010), obesity (Rasmussen et al. 2004, Donath and Amir 2008), prematurity (Chapman and Perez-Escamilla 1999, Flacking et al. 2007), prenatal breastfeeding knowledge acquired by attending breastfeeding classes in antenatal clinics (Fairbank 2000, Rosen et al. 2008, Semenik et al. 2008, Kristiansen et al. 2010), support from family and friends about breastfeeding (Battersby 2011) and if the mother has been breastfed herself (Ekström et al. 2003b). However, breastfeeding problems are common even among mothers who have the best circumstances and are highly motivated to breastfeed (Dewey et al. 2003).

### **1.1.3 Factors related to self esteem, depression and partner support**

Currently many studies point out factors related to self esteem which might even be more important for breastfeeding than socioeconomic factors (Scott et al. 2006). For instance self-confidence (Taveras et al. 2003, Britton et al 2008, Semenik et al. 2008), enhanced sensitivity during early infancy that in turn may foster secure attachment (Britton et al. 2006), and even self reported depression or symptoms of depression (Taveras et al. 2003, Britton et al 2006, Foster et al 2006). Stressful events during pregnancy may adversely impact on breastfeeding (Li et al. 2008), as well as the negative effect of anxiety, depression, irritability, or having a negative view of self (Yström et al. 2008). Other important factors affecting breastfeeding include partner support and how the new mother perceived her partners' attitude towards breastfeeding (Scott et al. 2006) and paternity leave (Flacking et al. 2010).

### **1.1.4 Factors related to mothers personality, knowledge, attitudes**

The initiation and duration of breastfeeding depends on many variables. For instance, it is common among breastfeeding women to believe that they don't have enough milk (Hillervik-Lindquist 1991, Kronborg 2004, Sosial- og helsedirektoratet 2008). Studies have also shown that some women want to go back to work, others want freedom or independence, or want other family members/partner to share in the feeding of the baby (Shepard et al 2000, Lavelli and Poli 1998, Wiesenfeld et al. 1985). Some women breastfeed for the baby's sake, some for both the baby and herself, while other mothers feel the need to control how much milk the infant takes and how much weight the baby has gained (Khoso 2000). There are also women who seem to view breastfeeding as

proof of being able to function as a woman, fulfilling society's expectations of being a good mother (Zwedberg 2010). Further, studies have shown that a reason to stop breastfeeding is because the infant's father holds negative views towards breastfeeding and prefers bottle-feeding (Arora et al. 2000). According to another study, some women who were bottle-fed themselves had a more positive view of bottle-feeding (Lavelli and Poli 1998). Women with breastfeeding difficulties reported that they have a high expectation of breastfeeding success and the difficulties they encounter were unexpected (Shakespeare et al. 2003).

### **1.1.5 Economic perspectives**

Some other factors that influence breastfeeding globally could include women's lack of knowledge about the tension between the diverse social and economic pressures put on women to consider using baby formula and food, rather than breastfeeding and breast milk (Donnelly et al. 2000 Review, Merewood and Philip, 2000). Certain companies benefit from women who may lack the confidence to make the decision about how to best care for the infant, by extolling the various benefits of packaged nutrition. These companies promise a scientifically based product, easy to use, and satisfying to all – even the male partner. World Health Organization (WHO) and The United Nations Children's Fund (UNICEF) have taken a number of proceedings/initiatives in order to protect, promote and support breastfeeding. In 1979 a joint WHO/UNICEF meeting on Infant and Young Child Feeding took place. The meeting recommended an international code of restricting marketing of breast milk substitutes and a code was launched in 1981 by WHO in order to protect breastfeeding (WHO 1981).

### **1.1.6 Factors related to hospital staff**

A stressful hospital environment may also negatively influence breastfeeding. For instance, one study documented how often staff entered the maternity room and found that frequent entries by staff caused new mothers to feel stressed and not relaxed in breastfeeding situations (Morrisson et al. 2006). A lack of awareness and negative attitudes among health care professionals can also obstruct exclusive breastfeeding (Ekström et al. 2005). Ekström et al. (2005) identified four types of attitudes among health staff in Sweden, the “regulator”, the “facilitator”, the “disempowering”, and the “breastfeeding opponents”. It was found that mothers who were cared by “facilitators” talked more to their infants, were more likely to perceive that their infant was their

own, were more likely to enjoy breastfeeding, understand their baby better, and even found that their babies cuter than those mothers who had other types of staff even nine months after the baby was born (Ekström and Nissen 2006). Mothers complain that they get conflicting advice about breastfeeding from staff which might interfere with breastfeeding (Zwedberg 2010). The most commonly described barriers in breastfeeding counseling are the limitations in breastfeeding knowledge among nurses, midwives and physicians. This lack of knowledge was identified in a review analyzing 40 studies from Sweden, Finland and England (Laanterä et al. 2011, Review).

### **1.1.7 Factors related to hospital practices**

Most of those factors have been identified by internationally renowned researchers. Most interventions of recommended perinatal practices derive from The Ten Steps for Successful Breastfeeding sponsored by the WHO/UNICEF Baby-Friendly Hospital Initiative (BFHI) (WHO 1989). BFHI was launched globally in 1991 by WHO and UNICEF with the aim to establish breastfeeding-friendly routines at the maternity wards. The initiative was based on the “Ten Steps to Successful Breastfeeding” which defines the framework for this initiative, as well as concrete steps for creating routines that will protect, promote and support breastfeeding. BFHI has been revised, updated and expanded for integrated care by WHO in 2009 (WHO 2009). In the “Ten Steps to Successful Breastfeeding” every facility providing maternity services and care for newborn infants should:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within half an hour of birth. WHO 2009: Place babies in skin-to-skin contact with their mothers immediately following birth for at least an hour. Encourage mothers to recognize when their babies are ready to breastfeed and offer help if needed.
5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborn infants no food or drink other than breast milk, unless medically indicated.

7. Practice rooming-in - that is, allow mothers and infants to remain together - 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

Breastfeeding initiation and success is strongly influenced by this delivery and maternity care routines, hospital policies and support, in positive and negative ways (DiGirolamo et al. 2008).

### **1.1.8 Cesarean section birth**

Hospital practices such as cesarean sectioned birth also influence breastfeeding. The cesarean delivery rate has increased progressively in developed countries, including Sweden. In 2005, the cesarean section rate was 30% in the United States, 25% in Europe and 17% in Sweden, as compared to the Swedish rates of 10% in the early 1990s and 5% in the early 1970s (Lavander et al. 2006 Review).

Rates of cesarean sections have increased and today the rate is 20% of all deliveries, where half are planned and half are emergency sections. Cesarean sections are safer today than they were in the past, and attitudes about them have changed, which is one of the reasons they have become so popular. Today a c-section is performed if the baby is in a breech position, which was not always the usual practice. About five percent of these operations are performed because of psycho-social reasons, such as fear of delivery. Another reason why cesarean sections have become more common is that many women are overweight. Thus, cesarean sections are now seen as a acceptable alternative that may be chosen instead of a vaginal birth. In fact in Sweden, some women even believe it is their right to have a cesarean section, if they so desire (Stjernholm-Vladic et al. 2010). In Sweden, the general health care system absorbs the cost of the operation, so costs to individual women of the operation are not a factor.

Some studies have investigated the effect on breastfeeding and on mother-infant interaction when the mother has delivered by a cesarean section. It is been reported that the duration of breastfeeding has been shorter after cesarean section than after vaginal delivery, and that a cesarean section is associated with more frequent partial



breastfeeding (Carvalhaes et al 2003, Scott et al. 2006, Häggkvist et al. 2010). Women who had experienced a cesarean section found breastfeeding more stressful, had more breastfeeding difficulties, and were more sad than women who had experienced a vaginal delivery, three and nine months after delivery (Carlander et al 2009). Furthermore, symptoms of post-traumatic stress are associated with mothers who have experienced an emergency cesarean (Tham et al. 2007). Other conditions which negatively affect breastfeeding and infant care include post operative pain (Karlström et al. 2007). The risk of negative birth experience was much higher in emergency cesarean than in planned cesarean (Karlström et al. 2007). There was a delayed first suckling compared to mothers who had a vaginal delivery. In hospitals that were not baby friendly, the delay was even longer than in hospitals that were baby friendly (Rowe-Murray and Fisher 2002).

### **1.1.9 Hormonal changes during breastfeeding**

Oxytocin and prolactin are two hormones crucial for lactation. Oxytocin is a nonapeptide, both a hormone and a neurotransmitter. Prolactin is released from its production site in the anterior lobe of the pituitary gland. Oxytocin is released from its production site in the hypothalamus and from stores within the pituitary gland. Both are released in response to sensory stimuli. Oxytocin is secreted into various regions in the brain and into the peripheral circulation. Oxytocin is transported via the neurohypophysis to reach the target organs such as the uterus and mammary glands via the circulation where it has a half-life of one to two minutes (Ludwig and Leng 2006). Oxytocin secretion increases during pregnancy to reach high levels during labor and the postpartum period. After birth maternal oxytocin levels are elevated in connection with expulsion of the placenta and remain elevated for about 60 minutes postpartum before returning to pre-partum levels (Nissen et al. 1995). Maintenance of prolactin and cortisol secretion is necessary for initiation of milk production and ejection reflex (Neville and Mortan 2001). Following birth, oxytocin is also a prerequisite for the milk ejection reflex, also called the let-down reflex (Lincoln and Paisley 1982). Oxytocin is released into the circulation every time the infant suckles and the breast sensory fibers in the nipple are thought to be activated when the nipple is stretched (Geddes 2009, Prime et al. 2009). As a consequence of the circulating oxytocin, the blood vessels in the mother's chest dilate (Lind 1969, Burbacch et al, 2006). Prior to suckling, maternal

oxytocin can also be released when mother and infant are in close skin-to-skin contact and when the infant massages the mother's breast (Matthiesen et al, 2001).

Maternal stress seems to hamper the release of oxytocin which in turn may inhibit maternal relaxation and the ability to release milk (Newton and Newton, 1948, Theodosis et al. 1994). If the milk ejection reflex is not elicited repeatedly it may result in an incomplete removal of milk from the breast. This leads to down-regulation of milk synthesis (Neville and Mortan 2001). It may also increase the risk for mastitis (Lundin 2005, Nelsen 1753). Milk removal by infant suckling or by expressing milk manually or by breast pump does not necessarily trigger milk production. It may affect the timing of the onset of milk production or the volume of milk produced (Neville and Mortan 2001, Chapman and Perez-Escamilla 2000). However suckling within the first hour postpartum may trigger optimal milk volume (Bystrova 2007).

Oxytocin stimulates prolactin secretion (Jonas et al. 2009, Samson et al. 1986). Prolactin is the prerequisite to initiate milk production during the initiation. During each breastfeeding session prolactin increases. After the session it returns to pre feeding level (Battin et al 1985, Johnston and Amico 1986). After month of breastfeeding large volumes of milk are maintained despite rather small increments of prolactin during the breastfeeding session. The basal level of prolactin 4-5 months post partum predicts the remaining period of breastfeeding (Uvnäs-Moberg et al. 1990b). However, if there is a lack of oxytocin the release of prolactin in response to suckling is hampered (Samson et al. 1986).

Oxytocin has also been shown to facilitate bonding between mothers and their children (Feldman 2007, Levine et al. 2007). During suckling, when oxytocin is released into the circulation and probably into the brain, behavioral and physiological adaptations occur in the mother (Jonas et al. 2008, Leng et al. 2008). Interestingly, in the central nervous system the half-life of oxytocin is notably prolonged, about 20 minutes compared to the half lives observed 1-2 min in the circulation (Burbacch et al, 2006, Ludwig and Leng 2006). During breastfeeding, mothers experience pleasure and a sense of wellbeing. Their levels of somatic anxiety are reduced and their social skills are increased (Nissen et al. 1998, Jonas et al. 2008). It has also been suggested that prolactin is involved in the initiation of maternal behavior (Mann and Bridges 2001) which illustrates the close intermingling between oxytocin and prolactin.

## **1.2 SWEDISH CONTEXT OF BREASTFEEDING**

Historically, health care practices have influenced breastfeeding rates in Sweden for several centuries. Documentation of these practices began in the 1800's when the medical discipline regarding the care of the child had its beginning. Prior to this time, the child's upraising was the total prerogative of the family. Then during the 1900's medical professionals began to have ideas about how infants should be fed and even disciplined, and breastfeeding began to be regulated. Regulation of breastfeeding was considered the best way to bring up the infant (Ekenstam 1993, Folkhälsoinstitutet 1998, Ohrlander 1992). Breastfeeding was looked upon as a "meal" and in between feedings infants were supposed to remain in their beds. Mothers were advised to not to listen to the babies' cries, nor spoil the child with too much physical closeness. They were advised not to pick up the child from the bed when he or she fussed (Jundell 1927). Thus, the baby should be "taught" how to behave in an "ideal" or well brought-up fashion.

Breastfeeding rates in Sweden began to decline rapidly when most women in Sweden began to give birth in hospitals in the 1940s. At this time, maternity ward routines separated mothers and babies and did not often promote positive breastfeeding attitudes. Later, there was a negative impact of the advertisement campaigns conducted by baby formula and food companies that triggered a further decline in breastfeeding mothers. Breast-feeding rates reached its lowest at the beginning of 1970's in Sweden. Breastfeeding was highly regulated by the same pattern as bottle-feeding, frequency feeding and with a certain amount of milk each feed, controlled by weighing the baby before and after each breastfeeding. If not enough breast milk was ingested, according to the standards of how much breast milk should be ingested, the infant was supplemented for the amount calculated to not have been ingested, and the infant was then fed by bottle with a certain amount formula supplementing the missed amount of breast milk. It then became a common idea that the baby had not received enough milk and that the mothers could not produce adequate amounts of milk (van Esterik 1988). These ideas started to impact the ways babies were fed and more and more often staff and mothers started to rely on bottle feeding because the amount of formula could be controlled (Svensson and Nordgren 2005). Few women managed to maintain their milk production when they were advised to breastfeed every four hours and also produce certain amounts at each feeding time. Breastfeeding support was also insufficient.

### **1.2.1 The Swedish practice rooming-in**

In the early 1970s, rooming-in during the daytime was introduced and quickly accepted in Swedish hospitals. During this period, staff and mothers in hospitals were discussing the merits of mothers and babies spending the night together. Night rooming-in was not an option for mothers at the maternity wards in Sweden. The most frequent reasons given for not having the baby in the mother's room during the night include monitoring the infant's health and giving "medical care". Another opinion that was generally held by the staff at that time was that mothers did not want to room-in with the baby, since it would mean too many mothers and babies in the same room, resulting in too much noise. Some staff believed that it was better if the baby stayed with the mother during the night so she could breastfeed instead of being fed with formula in the nursery by the staff.

In 1973, Sweden had the lowest breastfeeding figures ever. Then the trend began to change. One of the factors was that women themselves wanted to breastfeed and got support from the "green movement" in society. The breastfeeding mothers support group, in Sweden called Amningshjälpen, was organized and helped women with advice because the decline in breastfeeding had led to a common lack of knowledge about how to breastfeed. Increased knowledge about the benefits of breastfeeding promoted this attitudinal change and brought about a sharp increase in the frequency of breastfeeding.

In Sweden the Baby Friendly Hospital Initiative BFHI was introduced in 1992 by Ministry of Health and Social Affairs and the National Board of Health and Welfare. During a period of 5 years the maternity wards in Sweden were evaluated and assessed as "baby-friendly" (SOU 1993). Between 1992 and 1995, all hospitals in Sweden were certified as Baby Friendly Hospitals. One of the ten steps, number 7 recommends that mother and baby should remain together day and night during the hospital stay. Night rooming-in in Sweden was implemented in the mid-1980s. There was studies indicated that mothers' sleep during the night did not suffer from rooming-in (Keefe 1988). In addition, another study reported that infants who roomed in with their mothers had more "quiet sleep" and cried less than infants who remained in the nursery (Keefe 1987). A Swedish clinical study by Waldenström and Swenson found that an increase in the time the baby spent in the mother's room did not decrease the mother's hours of sleep, nor was her alertness affected by rooming-in (Waldenström and Swensson 1991).

Thus, in the first half of the 1990s the frequency of breastfeeding continually rose when Baby Friendly Hospitals were implemented. The 10 Step program was successfully adopted in both maternity hospitals and later in the well baby clinics. However, by 1996 breastfeeding rates started to decline again. The reason for this decline has not been investigated (SOU 1993).

In 1997 the Swedish National Institute of Public Health revitalized the initiative and reevaluated the maternity wards as well as extended the initiative to include antenatal and child health care. Until 2003, 63% of the maternity wards were reevaluated and assessed as “baby-friendly” as well as 1/3 of all antenatal and child health care units in Sweden. However, since 2003 no national body has taken the responsibility for BFHI. In order to make breastfeeding friendly routines sustainable in maternity wards as well in primary health care, it is necessary to keep the initiative alive and continuously train health care professionals to support breastfeeding.

Today, breastfeeding rates in Sweden continue to be one of the highest in the Western world. The exclusive breastfeeding rate is 85% for all infants at the age of one week of age, about 71% at the age of two months, 60% at four month and 15% at the age of six months (National Board of Health and Welfare 2010). Breastfeeding continues to be one of the accepted indicators of a good health outcome for the infant (Save the Children 2004, Primary Child Health Care Annual Report 2009).

The meaning of breastfeeding is important and in Sweden it is generally considered to be a positive and healthy thing to do. However, there is also a discussion about whether women in Sweden feel a pressure to breastfeed. Swedish women who wish to breastfeed but fail to do so often express guilt and suffer from the feeling of being a “bad mother” (Khoso 2000, Zwedberg 2010)

Interestingly, discussions about “breastfeeding pressure” and the benefits of breastfeeding in our society are reflected in the Swedish media. Sweden may be unique in having questions concerning breastfeeding as a common medial issue. Because this is an emotional topic, breastfeeding becomes a topic of conversation for the general public. Surprisingly, media seems to sometimes turn against breastfeeding.

Present breastfeeding recommendations from the National Board of Health and Welfare and the Swedish National Food Administration 2003 are based on the following

statement: For the first period breast milk is the best nutrition for the child. Most infants manage perfectly on breast milk exclusively for the first six months of their lives. For nutritional reasons, breastfeeding ought to be supplemented from around six months with other food, but it is advantageous to continue to breastfeed, as breast milk constitutes a part of the diet throughout the first year of life or longer.

### **1.3 NATURAL INFANT BREASTFEEDING BEHAVIOR**

The full term newborn infant, when placed skin-to-skin at the mother's chest immediately after birth exhibits a pre-programmed biological behavior to approach the breast and start suckling without help (Widström et al. 1987, Ransjö-Arvidsson et al. 2001). This behaviour has recently been described in detail as an innate newborn behavior which, occur in nine phases/stages in a specific order. Within each of these stages, there are a variety of behaviors the baby may show. The stages can briefly be described as follows: First stage; *birth cry*, occurs when the infant makes an intensive cry immediately after birth. Second stage; *relaxation*, is evidenced by no movements in the infant's mouth, head, arms and legs. Third stage; *awakening*, shows the infant with a small thrust of head, shoulders and limbs, with open eyes, and some mouth activity. Fourth stage; *activity*, begins when the infant increases mouthing and sucking movements and the rooting reflex becomes more obvious. Fifth stage; *crawling*, occurs when the infant approaches the breast with bursts of creeping like movements. Sixth stage; *rest*, are evidenced when the infant takes periods of rest at any point between periods of activity. Seventh stage; *familiarization*, starts when the infant becomes familiar with the breast by licking the areola and nipple. Eighth stage; *suckling*, occurs when the infant takes the nipple, latches and suckles. Ninth stage; *sleep*, the final stage is when the infant falls asleep after some suckling (Widström et al. 2010). These nine newborn stages can be seen in the DVD "Skin-to-Skin the First Hour After Birth: Practical Advice for Staff after Vaginal and Cesarean Birth" (Healthy Children project 2010).

Although all stages are important for breastfeeding, the seventh stage will be described in more detail since it can easily be misunderstood and also be disturbed by some care routines. During the seventh stage, the *familiarization* stage, the infant starts to seek the breast; the rooting reflex becomes successively more mature and distinct. During a mature rooting reflex, the mouth is wide opened and ready to attach to the breast. At the

same time, the tongue is concomitantly positioned in the bottom of the mouth in order to be below the nipple/areola as the baby attaches to the breast with a forward movement with the head. Interestingly, prior to this rooting-tongue reflex, the baby makes licking movements, which are probably a program aimed at shaping the areola and nipple for easy attachment to as well as to transmit taste from the breast to the baby's mouth (Widström and Thingström-Paulsson 1993). This "familiarization" behavior can take up to 15 minutes before the baby attaches to the breast (Widström et al. 2010). During this period, the baby usually massages the breast with his or her hands, which increases maternal oxytocin levels. This rise in maternal oxytocin is considered an important aspect supporting milk ejection and maternal attachment or bonding to the infant (Matthiesen et al. 2001). Early opportunities to suckle provide the infant with colostrum and its important immunological properties (Hanson 2005).

#### **1.4 BENEFITS OF BREAST MILK AND BREASTFEEDING**

Breast milk is the ideal nutrition for a newborn with numerous components supporting healthy growth and development. Breast milk includes maternal antibodies that help the babies avoid, or fight off infections and gives their immature immune systems the benefit of the protective capacity of the mothers' immune system. The maternal immune system has had many years of experience with the germs common in the mother's environment (Hanson 2005). The breast milk changes in response to the feeding habits of the baby over time, thus adjusting to the infant's individual growth and development pattern. Breast milk is perfectly prepared for each newborn and is easily digested by the infant; it also enhances the absorption of fat and iron (Hamosh 1996).

Breast milk contains antibodies, mainly as secretory IgA, which are directed against all the microbes, which the mother previously and presently is exposed to and to which her infant most likely will meet from delivery on. They protect the infants' mucous membranes especially in the respiratory and gastro-intestinal tracts, areas of the body most often at risk for infection (Hanson 2005). Breast milk also contains numerous other proteins which have important biologic functions such as enzymes that contribute to digestion, hormones, and growth factors (Hanson 2005). This very wide range of biological components in breast milk provides a fully accessible defense and support for each breastfed infant (Hanson 2005).

The public health advantages from breastfeeding are shown in the latest review (Ip et al. 2009). The following infections have been found to be lower in incidence or severity in breastfed infants not only for children in low-income countries but also for high-income countries. These include: diarrhea, respiratory tract infections, otitis media, atopic eczema, asthma (young children), obesity, diabetes type 1 and 2, childhood leukemia and sudden death syndrome (Ip et al. 2009). Further, a recent Swedish study found that although asthma may persist over time even though the baby was partially breastfed, those children who did breastfeed had a significantly lower risk of asthma until the age of eight years (Kull 2010).

The known health effects of breastfeeding on mothers are a faster recovery from the birth experience, due to the fact that there is less bleeding (Henderson and Macdonald 2004). If breastfeeding is exclusive, and specific guidelines are followed according to the Lactation Amenorrhea Method (LAM) there are decreased risks for a new pregnancy (Peterson et al. 2000). Breastfeeding effects on mothers also include lowered risks for developing type 2 diabetes as well as for developing breast- and ovarian cancer (Ip et al. 2009). Early cessation of breastfeeding or not breastfeeding is associated with an increased risk of maternal postpartum depression (Ip et al. 2009).

Current research has continued to inform us on the maternal benefits of breastfeeding. There are both physiological effects for mothers such as lower blood pressure. Psychological effects facilitating adaptation to motherhood such as reduced anxiety and aggression and increased socialization compared to a normative sample of women who did not breastfeed (Nissen et al 1998, Jonas et al 2008).

## **1.5 SKIN-TO-SKIN CONTACT**

Another practice that has beneficial effects on both mother and infant is skin-to-skin contact. The infant crying decreases (Christensson et al. 1992). The baby with skin-to-skin contact stays warmer (Christensson et al. 1992, Chiu et al. 2005) has higher blood glucose (Christensson et al. 1992, Moore et al. 2007 Review) and it results in a more positive breastfeeding outcome (Mizuno et al. 2004, Conde-Agudelo et al. 2007 Review, Bramson et al. 2009, Gabriel et al. 2009). Skin-to skin also promotes optimal infant growth and development (Conde-Agudelo et al. 2007 Review) while simultaneously enhancing maternal emotional and psychological wellness (Sachdev 2003 Review) and decreasing maternal dissatisfaction (Carfoot et al. 2005). Another



major benefit of skin-to-skin contact suggested by Bystrova et al. is, that it decreases the negative effects of “the stress of being born” (Bystrova et al. 2003).

For premature babies studies of skin-to-skin interventions have indicated reduced infant mortality (Sachdev 2003 Review) and morbidity such as severe illness and infections (Sachdev 2003 Review, Conde-Agudelo et al. 2007 Review). Skin-to-skin also improves the physiological response of the newborn with maintained or improved stability (Bergman et al. 2004, Moore et al. 2007 Review ) particularly in respect to heart rate (Bergman et al. 2004, Conde-Agudelo et al. 2007 Review, Moore et al. 2007 Review), and respiration (Bergman et al. 2004, Moore et al. 2007 Review, Nyqvist et al 2010).

There are also studies which suggest that there is an early "sensitive period" within that first hour after birth during which close contact between mother and infant may induce long-term positive effects on mother-infant bonding and interaction (Klaus et al. 1972, De Chateau and Wiberg 1977, Anisfeld and Lipper 1983, Klaus and Kennel 1983, Wiberg et al. 1989, Conde-Agudelo et al. 2007 Review, Bystrova et al. 2009). Bystrova et al. (2009) have also showed that skin-to-skin contact the first hour after birth positively influenced maternal sensitivity on mother-infant interaction one year after birth, and increased the infants' capacity to regulate stress when tested one year after birth.

One recent study also found that the mean time to expel the placenta was quicker in the mother who had skin-to-skin contact with the infant directly after delivery (Gabriel et al. 2009).

When the mother is not available for skin-to-skin contact with the infant the father, partner or other adult can substitute the skin-to-skin intervention with the infant. It has also been shown that fathers who take care of the infant skin-to-skin directly after birth, such as when the mother has had a cesarean section, also have an important impact on the infants' wellbeing. Infants were more comforted; they stopped crying more quickly and became calmer than infants who remained in their cot (Erlandsson et al. 2007).

Furthermore, the respiratory adaption was more positive when the father held the infant skin-to-skin in an upright position (Erlandsson et al. 2008). Fathers randomized to skin-to-skin contact with their infants 30 minutes after birth with a planned cesarean section were vocally more communicative with the infant than fathers who did not have a skin-

to-skin intervention. These fathers also interacted more with the mother (Velandia et al. 2010).

## **1.6 SOME PRACTICES WHICH FACILITATE OR HINDER BREAST FEEDING**

Breastfeeding initiation and success is strongly influenced by hospital policies and support, in both positive and negative ways (DiGirolamo et al. 2008). For instance, some current Swedish practices which enhance breastfeeding could include skin-to-skin contact after birth (Bystrova et al, 2005), early initiation of breastfeeding (Chapman and Perez-Escamilla 1999, Ekström et al 2003) and rooming-in (Fairbank et al. 2000 Review). However, there are many labor and maternity “routines” that are known to negatively intervene with breastfeeding and directly or indirectly cause breastfeeding problems. Some of these practices include: unnecessary separation of mother and baby (Winikoff 1986), which may cause delayed first suckling (Chapman and Perez-Escamilla 1999, Ekström et al 2003a, DiGirolamo et al. 2001, 2008), supplementary feeds when not given for medical reasons (Dewey et al. 2003, Ekström et al. 2003a, Gagnon et al. 2005), or supplements given by bottle (Howard et al. 2003, Abouelfetoh et al. 2008, Huang et al. 2009). Medical interventions like cesarean section, epidural and spinal anesthesia complicate this picture even further (Baumgardner et al. 2003, Torvaldsen et al. 2006, Wiklund et al. 2009).

### **1.6.1 Breastfeeding problems**

Breastfeeding problems the first week post partum are associated with early cessation of full breastfeeding (Taveras et al. 2003, Häggkvist et al. 2010). Mothers who have breastfeeding problems within the first month postpartum had a higher risk for discontinuing full breastfeeding before six months (Scott et al. 2006). A breastfeeding clinic in Canada listed latching difficulties, painful nipples/breasts and low milk supply as the three most frequent major breastfeeding problems. Women said that the latch-on problem was the major reason for ceasing to breastfeed (Lamontagne et al. 2008).

#### *1.6.1.1 Latch-on problem*

Latch-on and suckling problems usually occur the first days after delivery. This often results in the practice of supplemental feeding of the infant which then may lead to the cessation of breastfeeding (Cadwell 2007). Latch on problems can also occur later on if

the infant gets sick or begins for some reason to be bottle fed with formula (Hörnell et al 2001). The problem may be related to the infant's body position in relation to the mother's breast and the latching reflex of the infant (Blair et al. 2003). There are different types of infant latching on problems. For instance, some infants do not try to latch on, while others may not even locate the breast.

#### *1.6.1.2 Mastitis*

Mastitis in lactating women is also a common condition and often leads to the interruption of lactation (WHO 2000, Schwartz et al. 2002, Wöckel et al.2009). The incidence of mastitis in breastfeeding women differs between countries. In Sweden the incidence is 24 - 30%, in USA and Australia 8%, Pakistan 2.6% (Fetherstone 2001, Foxman et al.2002). Women with breastfeeding problems such as pain, cracked nipples, milk stasis and mastitis report a higher stress level after one year compared with women without breastfeeding problems (Abou-Dakn et al. 2009).

Mastitis usually ranges from a relatively short-lasting but painful period of inflammation in the breast to an inflammatory reaction of longer duration and with more severe symptoms (Fetherston 2001). Most (severe) mastitis is treated by continuous breastfeeding to empty the breast and with antibiotics. Although the standard practice is to treat mastitis immediately with antibiotics current research suggests that this may not be necessary. Many healthy breastfeeding women have potentially pathogenic bacteria in their breast milk but they do not develop a clinical manifestation of mastitis (Kvist et al. 2008). Other breastfeeding women with symptoms of mastitis so serious it looked like a septic reaction recovered without antibiotics (Kvist et al.2008). If the condition of mastitis persists, then antibiotics may be needed.

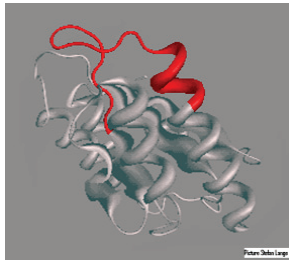
The cause of mastitis is not known but a number of risk factors related to initiation of breast- feeding are identified. Some of these risk factors include cracked nipples (Foxman et al. 2002, Abou-Dakn et al 2009), blocked ducts, alternating breasts in the same breastfeeding session, use of creams on the nipples and a past history of mastitis (Kinlay et.al 2001), older age and increased stress post-partum (Wöckel et al.2009, Abou-Dakn et al 2009), postpartum depression and low confidence (Flores-Quijano 2008). Even as early as 1753 it was known that mothers who breastfed on demand had

fewer breast complications (Nelson 1753). A complicated delivery may also increase the risk for mastitis (WHO 2000).

According to Kvist (2010) there is a lack of consensus among Western researchers/medical staff about the diagnosis and treatment of mastitis. Kvist further warned about a possible over use of antibiotics and the accompanying development of multi-resistant bacteriological strains as a result of too many antibiotics.

### **1.6.2 Anti - secretory factor**

There is a special developed product that prevents the onset of mastitis in the sow, as well as neonatal- and weaning diarrhoea in the piglets, that has been on the market for some 20 years in Sweden (Göransson et al. 1995, Witte et al. 2000, Lange and Lönnroth 2001). This feed act by stimulating the endogenous production of anti-secretory factor (AF), a protein which normalize the transport of water and ions across cell membranes (Johansson et al. 1997). The expressed AF protein and its cDNA have been characterized in detail (Johansson et al. 1995). AF and its peptide derivatives do not only regulate secretory processes, but also modulates the inflammatory reaction (Johansson et al. 1997, Eriksson et al. 2003a, Eriksson et al. 2003b, Lange et al. 1999). AF is stored, as well as synthesized, in most organs of the body, which has been demonstrated by immuno histochemistry and *in situ* hybridization in various tissues (Lange et al. 1999). Endogenous AF synthesis in man is increased by the influence of enterotoxins on mucus membranes, but also after intake of specially processed cereals SPC-Flakes (Björck et al 2000). AF activity can also be directly absorbed from the gastrointestinal tract after intake of AF-enriched egg-yolk (Eriksson et al. 2003a, Zaman et al. 2007). In humans as well as in animals the regulatory influence of SPC-Flakes AF-enriched egg-yolk has been studied in double blind clinical trials (Eriksson et al. 2003a, Göransson et al 1995, Zaman et al. 2007, Laurenius et al. 2003). Thus, in humans a significant correlation between the presence of AF in plasma samples and a positive clinical outcome have been demonstrated for Menière's disease (Hanner et al. 2003, 2009), inflammatory bowels disease (Eriksson et al. 2003a, 2003b, Björck et al. 2000), irritable bowel syndrome, carcinoid (Laurenius et al. 2003) and infectious diarrheal diseases (Zaman et al. 2007).



**Figure 2.** *AF-16 mark in red.*

AF is present in a biologically inactive form in healthy, non-infected persons, but is transformed into a biologically active form by gastrointestinal infections, inflammatory diseases and special feed (Lange and Lönnroth 2001). The active AF plasma level can be determined by an ELISA method (Johansson et al. 2009). The active forms of AF do not only contribute to the acute recovering from the diseases mentioned, but also mediates a more long-lasting resistance to the causative pathogen (Zaman et al. 2007). This immunity do not only seems to be protective specifically to one pathogen only, but to a multitude of pathogens capable of inducing hyper secretion and inflammation in the mucus membranes (Zaman et al. 2007). Increased understanding of AF action *in vivo* as well as *in vitro* might result in expanded clinical applications of the AF concept. The results so far advocate the importance to perform more studies focused on the regulative actions of AF in various pathophysiological conditions.

## **1.7 THE FOCUS OF THIS THESIS**

The focus of this thesis is to consider breastfeeding in respect to maternal practices in specific hospital settings in Sweden that impact the infant's successful breastfeeding. In our hospital we identified some delivery and maternity practices that could constitute possible risk situations which might impede breastfeeding in order to subsequently develop and test methods which would facilitate breastfeeding.

For instance, typical care practices such as caesarean section, and rooming in, as well as specific breastfeeding concerns such as problems with the infant latching on to the breast were studied. Since maternal inflammation of the breasts (mastitis) is related to care practices a method that possibly prevent mastitis was also studied. The literature has reported that women who give birth by caesarean section have more breastfeeding problems and/or breastfeed for a shorter time than mothers who deliver vaginally (Rowe-Murray and Fisher 2002, Carvalhaes et al 2003, Scott et al. 2006, Perez-Rios et

al. 2008, Karlström et al 2007, Carlander et al 2009). “Rooming-in” around the clock at the maternity ward has been shown to be the most important practice to support breastfeeding (Fairbank 2000).

Mastitis is a common problem for Swedish women. Mastitis is related to the practice of separating infant and mother postpartum, which can cause long intervals between breastfeeding and overfilled breasts which then constitutes a risk factor for mastitis. Thus, mastitis can lead to an early interruption of breastfeeding (Nelson 1989, WHO 2000, Abou-Dakn et al. 2009). Another major problem is that of infants with suckling/latch-on problems during the first months after birth. Latch-on problems are common during breastfeeding causing staff and parental stress and which may lead mothers to terminate breastfeeding earlier than desired (Dewey et al. 2003, Taveras et al. 2003, Häggkvist et al. 2010).

## **2 AIM**

**The overall aim** of this thesis was to identify delivery and maternity practices that can impede breastfeeding and develop methods to facilitate breastfeeding.

Specific aims:

To study whether the hormonal patterns of oxytocin, prolactin and cortisol differed between women delivered by emergency cesarean section or by the vaginal route and if these patterns show any relation to the duration of breastfeeding (Study **I**).

To investigate whether or not mothers in our hospital roomed-in with their babies at night, what were the attitudes of mothers toward night rooming-in and their feelings of closeness to their babies, and how mothers perceived hospital staff attitudes toward night rooming-in (Study **II**).

To determine whether anti-secretory factor (AF) can be induced in human milk (Study **III**).

To investigate if placing an “older” infant with latch-on problems skin-to-skin with the mother would positively affect the infants’ ability to latch-on when compared to those infants who did not have skin-to-skin contact. A study was conducted to compare experimental and control groups as to the following variables: 1) Proportion of infants latching-on; 2) Length of time until regular latching-on was achieved; 3) Maternal emotions before and during breastfeeding sessions (Study **IV**).

### 3 MATERIAL AND METHODS

#### 3.1 SETTING

Data for the studies was collected over two decades (1990-2004); the first three Studies (**I**, **II**, **III**) were collected exclusively from the Karolinska University Hospital in Solna located in Stockholm city, while the last study, Study **IV** was collected both at Karolinska University Hospital and at Danderyds Hospital in Danderyd located, on the periphery of Stockholm city. Both hospitals have approximately 5000 deliveries per year. What is important to note about this data collection is that it reflects a varied and evolving set of ward practices and beliefs which have been documented over time. These practices included, but were not limited to ideas about rooming-in, breastfeeding, caesarean section, father involvement in the labor and maternity ward, type of anesthetics, etc.

For instance, in the early 1970's infants were allowed to stay together with their mothers in the same room only during the day, but by the 1980s infants were allowed to remain with their mothers during the day and night. However, night-time rooming was not uniformly practiced in all maternity wards. Data were collected for Studies **I** and **II** (1990-91), just prior to the hospitals receiving the official designation of "Baby Friendly Hospital" in 1993 (WHO 1989). The Baby Friendly initiative included 10 steps for promoting, supporting and protecting breastfeeding (see page 5 for the 10 step program). Furthermore, in Sweden, this initiative also meant that mothers and babies had immediate skin-to-skin contact after birth, included in Step 4, as well as Step 7, night-rooming in. The ideas about proximity between mother and infant and the effects of skin-to-skin contact will be discussed in more detail later.

At the onset on Study **II** maternity wards had either single occupancy or rooms with 2-to-5 beds per room. Rooming-in could occur in all rooms. Mothers were given the option to room-in or not. The staff working at the wards were registered midwives, nurses and auxiliary nurses. Gynecologists, pediatricians and other medical specialists were also available when needed. During the time of data collection for Studies **I** and **II**, mothers with vaginal delivery usually stayed for three to four days in the maternity wards whereas mothers with caesarean delivery usually stayed 1-2 days longer. Rates of caesarean section at the time of Study **I** were 12% in Stockholm, with elective and



emergency evenly distributed. Common anaesthetics for caesarean were spinal or epidural analgesia.

Data for Studies **III** and **IV** were collected between 1998 and 2004. Night rooming-in was a common practice, but the rooms with more than two beds had been converted to double or single rooms. Fathers could stay overnight with the new mother and baby if they had been given a single room.

At the time of Study **IV** the caesarean rate had increased to 14% from year 1991 to 2001. The number of planned and emergency deliveries remained equally distributed through-out these years. A new practice of early discharge had begun at this time, so that new mothers with normal vaginal deliveries, and healthy babies left the hospital within the first 72 hours. Caesarean deliveries did not go home early. Rates of caesarean section at the time of Study **IV** in Stockholm were 18%, with elective and emergency still evenly distributed.

Common anaesthetics for caesarean were spinal or epidural analgesia. The frequency of epidural during vaginal delivery in Stockholm was 19% in 1998, but by 2004 it had increased to 34%. EDA at this time was 40% at the Karolinska and 27% at Danderyd; EDA was more common among primiparas. During this period the pharmacological substances had changed in respect to dosage and combinations of drugs administered.

The breastfeeding rate over time, for Studies **I** and **II**, as well as for Studies **III** and **IV** was very high. Approximately 98% of all newborns initiated breastfeeding the first week post partum. When Studies **I** and **II** were conducted, 51% of mothers' breastfed exclusively for 4 months while 17% of the mothers' breastfed partially. When data for

Studies **III** and **IV** were collected, the exclusive breastfeeding rates at 4 months increased to 69 % in 1998 but declined to 64% in 2004 while partial breastfeeding increased from 15% in 1998 to 19% in 2004 (National Board of Health and Welfare 2010).

### 3.2 STUDY OVERVIEW

**Table 1.** Overview Samples, design, data collection, analyses, instruments, statistical analysis

Data collection, analyses, instruments	Study I	Study II	Study III	Study IV
<b>Year of collection</b>	1990-1991	1990	2002	1998-2004
<b>Day of collection post partum (pp)</b>	Day 2 pp	Day 3 - 4 pp	Day 3 - 7 pp	Day 6 - 16 weeks pp
<b>Patient sample</b>	37 mother infant pair	111 mother infant pair	29 mother infant pair	103 mother infant pair
<b>Design</b>	Quasi-experimental study	Descriptive study	Randomized study	Randomized study
<b>Biomedical sampling</b>				
- blood	x			
- milk			x	
<b>Biomedical analyses</b>				
- oxytocin	x			
- prolactin	x			
- cortisol	x			
-anti-secretory factor (AF)			x	
<b>Physiological measures</b>				
- blood pressure	x			
- milk intake	x			
<b>Demographic variables</b>				
- questionnaires		x		
- hospital/birth records	x			x
<b>Psychological aspects</b>				
- KSP	x			
- Attitudes scale towards night rooming-in		x		
- Breastfeeding (BF) Emotional Scale				x
- BF Physical Pain Scale				x
<b>Statistical analysis</b>				
- Chi square	x	x	x	x
- Fisher's exact				x
- Mann Whitney U test	x	x	x	x
- Wilcoxon signed rank test	x			
- Spearman rank correlation coefficient	x			
- Simple regression				x
- Logistic regression	x	x		
- Multiple regression		x		
- Exploratory factor analysis		x		
- Permutation test			x	

### 3.3 DATA COLLECTION AND METHODS

Data collection methods for the four different studies were selected to answer questions related to breastfeeding. Breastfeeding is a complex phenomenon which includes cultural as well as biological, medical, physiological and psychological factors. The data collection methods summarized below illustrates a holistic methodological approach to meet the complexity of breastfeeding theoretically, clinically, and practically.

**Bio-medical sampling** occurred in two of the studies. Maternal blood samples were taken (I) and breast milk was collected (III).

*Blood sampling (I):* Blood sample was collected in a specific order, see figure 4.

*Milk sampling (III):* Five ml milk was collected for the milk sample in order to test for anti-secretory factor (AF).

**Biomedical analyses** were performed to ascertain levels of the following three hormones in blood: oxytocin, prolactin, and cortisol (I). Breast milk samples were analyzed to ascertain levels of anti-secretory factor (AF) (III).

*Blood samples (I)* were collected from the women in ice-chilled tubes containing trasylol (500 KIU/ml) and heparin (10 IU/ml). After centrifugation at +4° C, the plasma was taken off and the samples were stored at -20° C until they were analyzed.

*Hormone determinations (I)* Oxytocin, prolactin and cortisol samples were analyzed by radio-immuno-assays (RIA). Oxytocin immunoreactivity was measured by RIA after prior purification of plasma with SEP-PAK C<sub>18</sub> cartridges (Water Assoc.Inc., Milford, PA, USA). The antibody KA<sub>19</sub> was used for the analysis (Milab, Malmö, Sweden). Oxytocin was measured in all samples. Prolactin and Cortisol (I) were measured with a commercial kit (Farnos and Orion.Diagnostica, Orion Corporation, Turku, Finland) according to the manual.

*Determination of anti-secretory factor (AF) activity in milk (III).* The anti-secretory (AF) (III) in the milk was determined by intravenous injection of milk samples into rats measuring their capacity to prevent secretion into a gut loop of a rat injected with cholera toxin (for more detail of this procedure see Lange and Lönnroth 2001).

**Physiological measures** were collected: maternal blood pressure (II), milk production (III), and infant weight (II).

*Measurement of blood pressure (I)* Blood pressure was measured with a Reckling Hansen Minimus manometer at onset and conclusion of breastfeeding episode.

*Breastfeeding milk intake (I)* To calculate the amount of ingested milk, the infants were weighed before and after breastfeeding on the same scale, a Seca manual balance accurate to 5 grams.

**Demographic variables** were collected: maternal background variables (I, II, III, IV), hospital records for mother and infant (I, IV).

*Demographic background data (II).* A questionnaire on demographic background data was filled in by the women. Variables included age, parity, education, delivery mode, anesthesia and infants gender.

*Hospital records / Birth record (I, IV)* Health and socio-economic background data including age, education, marital status and obstetric data as well as data for infants were collected from the antenatal and hospital records

**Psychological aspects** were considered using the Karolinska Scales of Personality (I), mother's attitudinal scales for night rooming-in and perceived attitudes of the staff (II), Breastfeeding Emotional Scale (IV) and Breastfeeding Physical Pain Scale (IV). The psychological instruments used included:

*The Karolinska Scales of Personality (I)* The Karolinska Scales of Personality (KSP) is an inventory developed by Schalling and co-workers (af Klinteberg 1985) which record personality traits that are stable throughout life (Björvell 1985, af Klinteberg 1985). It consists of 135 items with a four point response format ranging from 1, "agree completely" to 4 "do not agree at all". The KSP was filled in to map the anxiety proneness of the women which consisted of four scales: psychic anxiety, somatic anxiety, muscular tension and lack of assertiveness scale.

*Attitude Scale to night rooming-in (II).* An attitude scale to evaluate the mothers' attitude to night rooming-in and importance of closeness to the infant was developed

for the purpose of study. The scale included 12 statements regarding topics such as night rooming-in, worries about sleep, sensitivity to noise, and the importance of mother-infant closeness. Mothers indicated their attitudes by circling “strongly disagree”, “disagree”, “agree” or “strongly agree”. In addition, they were asked about their perception of where the staff thought the infants should sleep at night, that is, in the nursery or with the mother. Four factors were identified in the attitude scale, which are named as follows: factor 1) “Importance of mother-infant closeness”; factor 2) “Worries about own and baby’s need of sleep”; factor 3) “Night rooming-in: good or bad”; and factor 4) “Sensitivity to disturbing factors”.

*Breastfeeding Emotional Scale (IV)* The Breastfeeding Emotion Scale was developed for the purpose of this study in order to assess maternal feelings in relation to a breastfeeding session. Mothers assessed their feelings regarding 12 emotions corresponding to a 7-point semantic differential scale with the following end points representing opposite values, such as “calm-stressed”, “fragile – strong”, and “contented – frustrated”. This instrument was filled in twice, once before and once during, administered after breastfeeding attempt, at two different points in time.

*Breastfeeding Physical Pain Scale (IV)* When mothers filled the Breastfeeding Emotion Scale, they also assessed their feelings of physical pain related to breastfeeding *before* and *during* first breastfeeding attempt. The Breastfeeding Physical Pain Scale was a 7-point semantic differential scale with words representing opposite values, such as; “severe pain - no pain”.

### **3.4 RECRUITMENT OF SAMPLE, INCLUSION CRITERIA, PROCEDURES, DROP OUTS**

Each study will be presented individually in order to facilitate understanding of the study specific procedures, including sample, inclusion criteria and drop outs. Each study has a flow diagram to further explain the sample size and drop outs. Some studies also include a chart explaining how samples were collected.

### **3.5 STUDY I.**

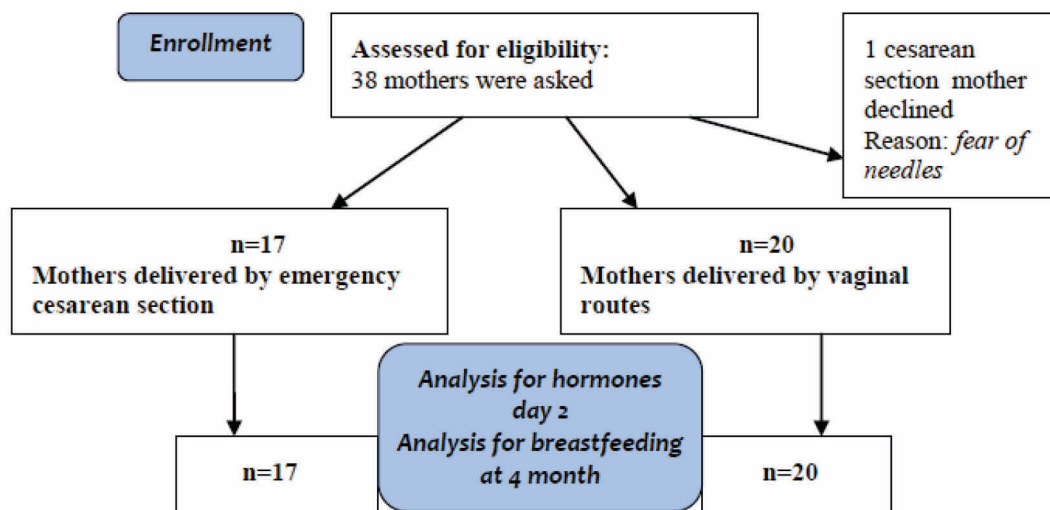
#### **3.5.1 Recruitment of sample**

Mothers and infants were selected from the hospital birth register on the first day after giving birth. If more than one mother was eligible to participate, the woman who gave

birth at the earlier hour the previous day was included. Thirty-eight women were asked to participate but one mother declined because she was afraid of needles.

### 3.5.1.1 Inclusion criteria

Primiparous women were included in the study if they fulfilled the inclusion criteria; an uncomplicated pregnancy, had not smoked during the third trimester nor during the first 3 days after birth, who gave birth to a full term, healthy infant with an Apgar score of at least 7 at 1 minute after birth.



**Figure 3.** Flow diagram of numbers of mothers given birth by caesarean section and vaginal route in Study I.

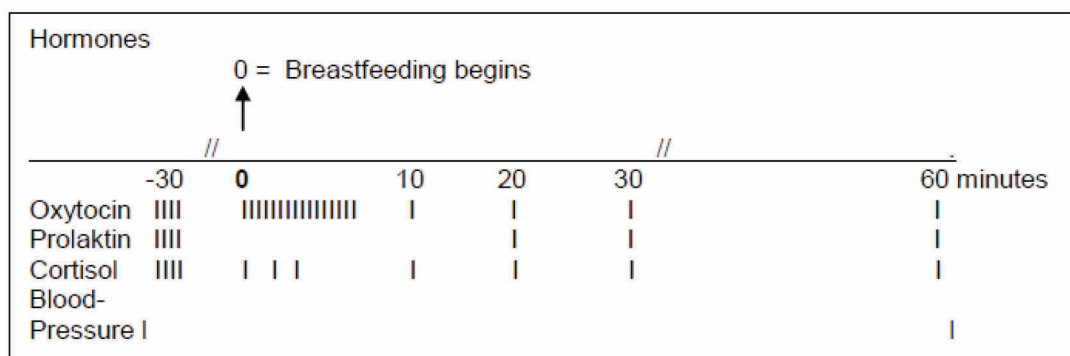
### 3.5.2 Procedure

The day of the blood sampling the mothers had a standardized breakfast at 7.30-8:00 (two sandwiches and a cup of tea or coffee). On day two *after the delivery* at least 30 minutes before the second breastfeeding in the morning between 9.00 and 11.00 an intravenous cannula was inserted into an antecubital vein. Four basal samples of blood were drawn at 30-second intervals before breastfeeding started. At this time the infant was weighed and the weight recorded.

As soon as the infant indicated an interest in nursing the baby and mother were made comfortable with pillows. The infant was positioned on one breast/or in front of the breast, with the opposite maternal arm free to hold the infant. The arm closest to this breast was the arm from which the blood was drawn, was also supported by a pillow. As soon as the infant started sucking the breast a series of blood samples was drawn

from the mother. The samples were taken every 30 seconds for a total of 7.5 minutes, after which blood samples were collected at 10, 20, 30, and 60 minutes from the start of this breastfeeding episode. Each blood sampling took about 15 seconds to draw. Altogether 24 samples of 5 ml blood were collected from each mother.

Blood pressure was measured before the basal samples were drawn and at the end of breastfeeding (after 60 minutes). After the breastfeeding the infant was weighed. A questionnaire about the duration of breastfeeding was sent to the mothers within two months after delivery, which they returned by mail.

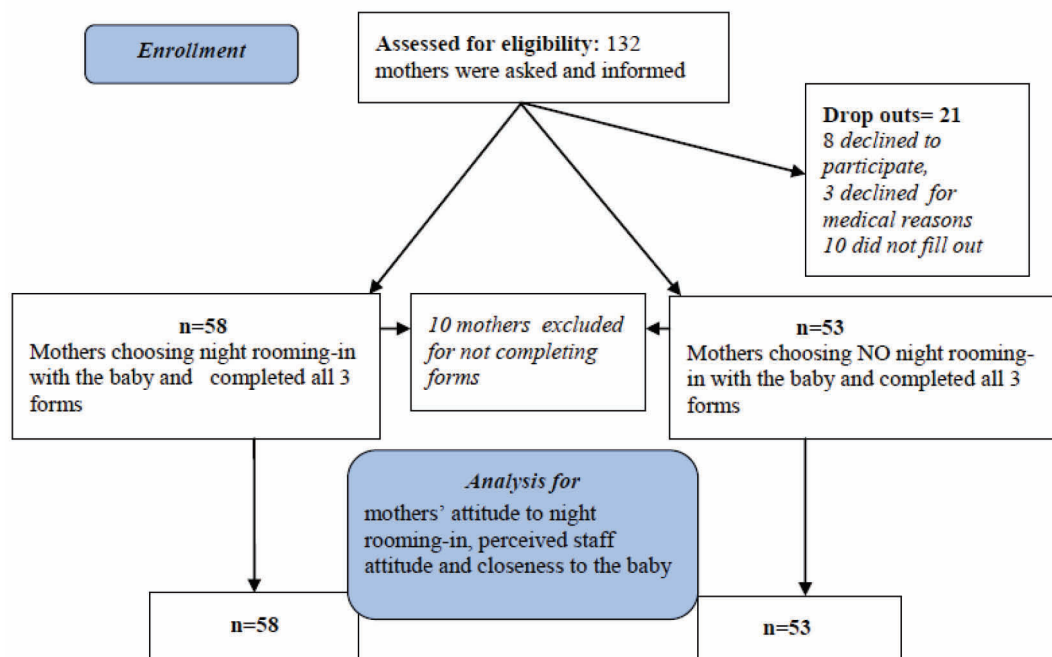


**Figure 4.** Intervals in minutes which blood sampling was taken.

### 3.6 STUDY II.

#### 3.6.1 Recruitment of sample and inclusion criteria

All mothers admitted to the maternity ward during a 2-week period in May 1990 were recruited upon admission to the ward. They were asked to participate in the study if they were of Nordic ancestry and were able to read and understand Swedish. Out of the 132 mothers who were asked to participate, 8 declined.



**Figure 5.** Flow diagram on numbers of mothers choosing night rooming-in (NRI) or no night rooming-in and the progress through the phases in Study II.

### 3.6.2 Procedure

When mothers were admitted to the maternity ward they received written information about the study. They also received written information about routines that facilitated night rooming-in. The mothers were placed wherever a room was available, and placement was thus a matter of random availability. A baby cot was provided for mothers to use at her discretion. Mothers were given the option to room-in or not. The mothers were asked to note daily in the diary sheet where the baby slept during the night. The mothers filled in two questionnaires at the day of discharge on background data and their attitudes to night rooming-in (“Attitude Scale”). Women then put the questionnaires in a sealed envelope and deposited them in a box at the ward.

## 3.7 STUDY III.

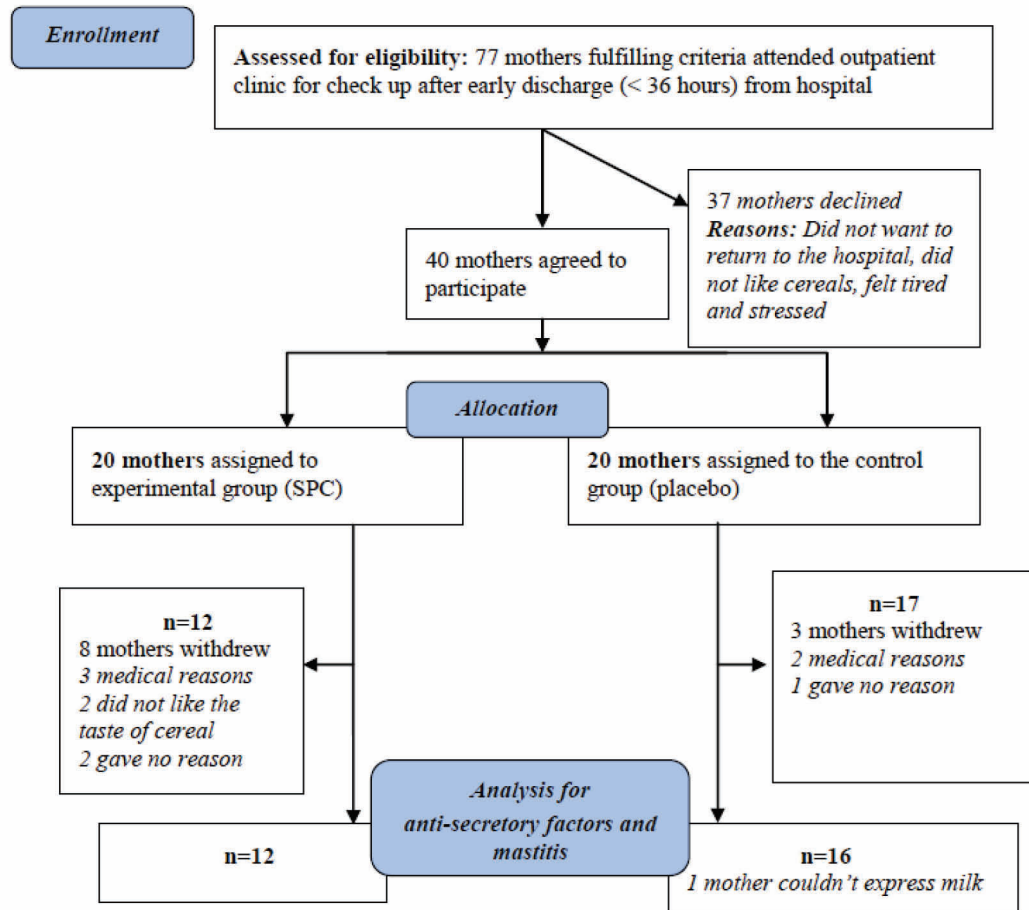
### 3.7.1 Recruitment of sample

All mothers coming for a post-partum check up at the hospitals’ outpatient clinic within 3–7 days after birth were asked to participate in the study. Seventy-seven women were asked to participate; 37 women declined because they either did not want to return to the hospital for follow-up visits, and/or they did not like to eat cereal for breakfast.



### 3.7.2 Inclusion criteria

All healthy mothers who were Swedish or who were brought-up in Sweden, and who were discharged within 36 hours postpartum from the delivery ward were recruited if they had a normal delivery with a healthy full-term infant, were fully breastfeeding and had an appointment at the hospitals' outpatient clinic for check-up.



\*The capacity to induce AF was damaged due to using the cereal for baking.

**Figure 6.** Flow diagram of progress through the phases in Study III.

### 3.7.3 Procedure and data collection methods

Mothers who agreed to participate and fulfilled the inclusion criteria were randomly assigned (sealed envelopes opened consecutively) to one of two groups. The randomization was blocked for time. The experimental group received hydrothermally processed cereals (HPC) (Björck et al.2000) also named special proceeded cereals (SPC). The control group received the same type of food, but with the SPC replaced by ordinary cereals without specific AF-inducing properties (placebo food). Active and placebo food had the same taste, appearance, and content of energy and nutrients. Both mother and researcher were blind to the content of the bags. The randomization

sequence was concealed until data had been obtained and laboratory analyses had been performed. The mothers were instructed to have a daily intake of 1dl (approximately 50 g) of the advised cereals for every breakfast for 5 weeks.

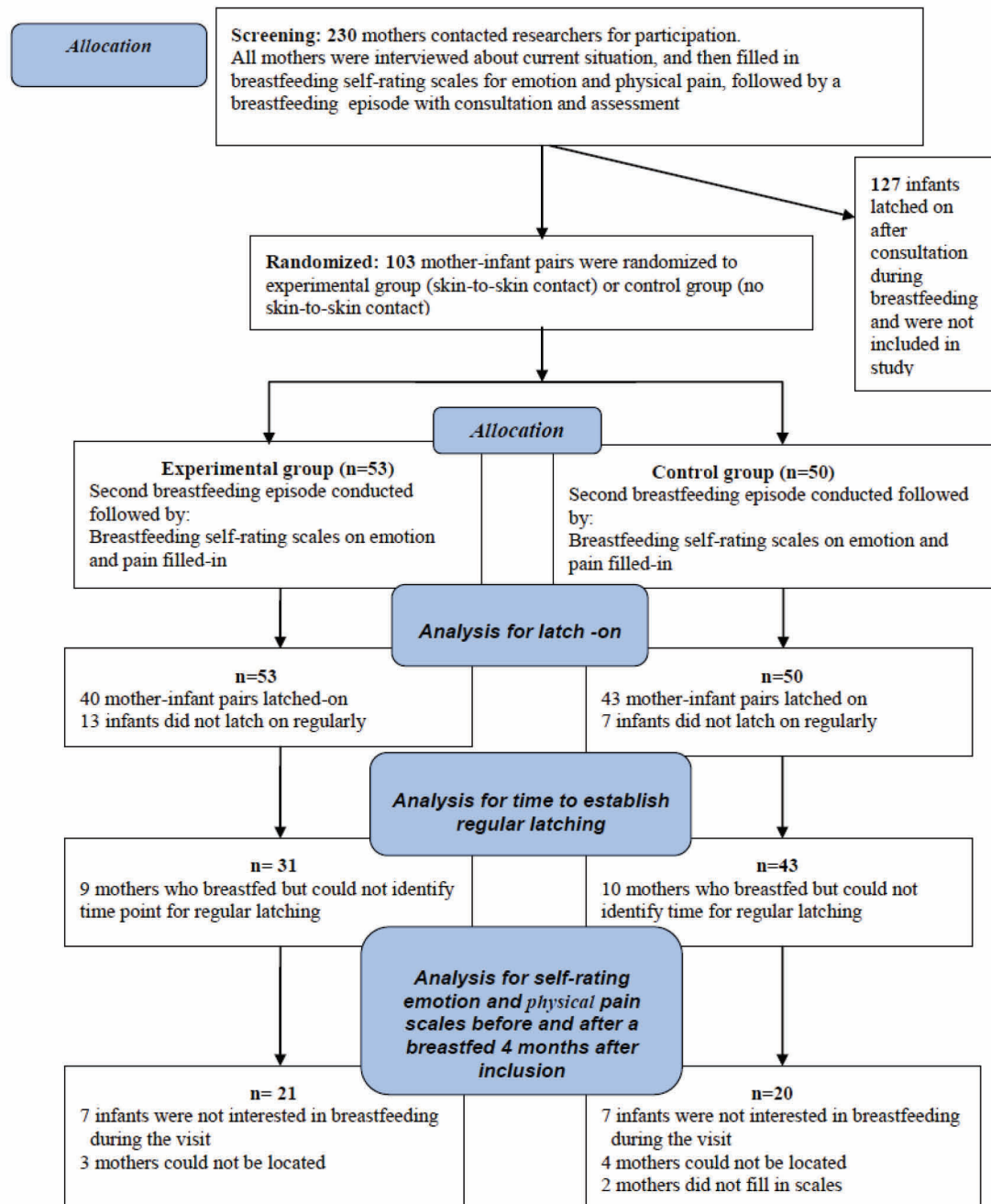
Upon entering the study, the mothers were interviewed about their background data, any signs of allergy and habits of eating cereals. The mothers were checked for breastfeeding status, including the investigator's diagnosis of breastfeeding complications such as breast inflammation (mastitis). The mothers were asked to note in a diary their daily cereal consumption. When the mothers had eaten the cereals for the required time, they were asked to collect 5 ml of milk into a sterile container and to keep it frozen at -20°C until the next appointment at the clinic. At the second visit, after the mothers had taken the cereals for 5 weeks, they were interviewed about their intake of cereals and how much cereal remained. An additional interview was performed to determine breastfeeding outcome as exclusive or partial.

### **3.8 STUDY IV**

#### **3.8.1 Recruitment and Inclusion Criteria**

Before and during the recruitment period the staff at the maternity wards at the two hospitals, well baby clinics and breastfeeding out-patients' clinics were informed about the study and the inclusion criteria. A poster sized information sheet was also put on the walls in the maternity and well baby clinics. The staff informed mothers who had infants with latch-on problems about the study and the mothers themselves contacted the investigator about her willingness to participate at the hospital where the infant was born.

Healthy mothers with healthy infants with a severe latch-on problem (maternal assessment) called the researchers to indicate their interest in participation, and were given an appointment to be screened for a latch-on problem at the hospital. The mother's considered the following as latch-on problems when the infant 1) did not latch-on at all, or, 2) had started to latch-on on but discontinued; 3) latched-on superficially; 4) latched only on one breast; or 5) latched only with a nipple shield. Women were then included in the study if the latch-on problem was not resolved during this initial screening process with the investigators and if they were willing to continue in the study.



**Figure 7.** Flow diagram of progress through the phases in Study IV.

### 3.8.2 Procedure

A total of 230 mother-infant dyads with latch-on problems contacted the investigators and were verbally informed that the study would involve several instruments and that a breastfeeding episode would be assessed. An appointment was made for an investigator to meet the individual mother-infant pair in a private room in the hospital for this breastfeeding assessment. The investigators were two experienced and practicing midwives who are specialists in breastfeeding. These investigators were also breastfeeding consultants who regularly gave advice and support to new mothers in

their respective hospitals, using a standardized model to guide mothers with breastfeeding problems which they had developed. Briefly, this model includes how to: *a)* establish a dialogue with the mother, *b)* give her space and acceptance, *c)* comply with the mothers needs, *d)* attempt to respond to questions and bids for support, *e)* increase the support for the women's ability to breastfeed by pointing out positive and successful aspects, *f)* thus supporting maternal confidence and *g)* creating a sense of empowerment in the mothers to solve the problem themselves. Furthermore their model precluded touching either the infants directly, or the mother's breast. . This model was assessed by an outside reviewer. The reviewer found that there was reliability and consistency between the investigators and consultation method they used to give mothers support, feedback and convey information about breastfeeding (Gustafsson 2006). This type of supportive consultation was received by all mothers who made the initial appointment.

Information was given to all mothers about the randomized design whereby mother-infant pairs would have an immediate second breastfeeding assessment and consultation after being assigned to an intervention. Women were informed that there would be a one week check-up and a follow-up four months after inclusion.

#### *3.8.2.1 First breastfeeding episode with consultation and assessment (day 1)*

At the arranged time, the mother-infant pair met with one investigator in a hospital room equipped with a bed, an arm chair, and a table and chair. The goal was to speak with the mother about her current situation with the baby, including some specific medical information. They answered question about socio-economic background data, marital status and obstetric data as well as data for infants. Data were also collected from the antenatal and hospital records. These are presented in table 2.

Then mothers were asked to fill in breastfeeding self-rating scales for emotion and physical pain (see research tools), and then breastfeed her baby. The investigator sat together with the mother-infant pair so that she could see them clearly, and in close proximity be able to give advice and support to help the infant latch-on. Mothers were free to ask questions about breastfeeding and infant care during this consultation.

Several types of infant latch-on on problems were observed. Included in such behaviours are; no attempts at all to latch-on, failing to locate the breast, having the mouth wide open over the breast without attempting to latch-on, overactive rooting

reflex over the breast, fending off the breast with their hands, or crying frenetically. Some infants looked like they wanted to avoid the breast, just fell asleep or did not move at all but remained in a “frozen” position.

During this and all other procedures the comfort of the mothers and infants was a priority, so data collection methods were used only after the infant and mothers felt at ease. Thus, there was some flexibility in the order of the data collection schema. The time it took for each breastfeeding assessment and consultation ranged from 1-1 ½ hours.

During the first breastfeeding episode of consultation and assessment, 127 mother-infant pairs actually learned the latch-on technique, and were not included in the study. They were thanked for their participation and they went home. All data collected from these women was later destroyed. Remaining were 103 mother-infant pairs who did not latch-on and they continued with the second phase of the study which followed immediately.

#### *3.8.2.2 Randomization (day 1)*

Sample mother-infant pairs were randomly assigned to either the experimental (skin-to-skin contact during breastfeeding) or control group (no skin-to-skin contact during breastfeeding) as depicted. The randomisation was blocked for hospital (and thus investigator) as well as for time. In each of the two hospitals, the investigators consecutively opened the sealed opaque envelope containing group assignment in the mother’s presence. Mothers were given their assignments to either experimental or control group. Following this, mothers were given both oral and written information about details of their receptive randomization group. After the randomisation procedure mothers were asked to make a new breastfeeding attempt when the infant seemed ready to suckle. Both experimental group (n=53) and control group (n=50) mothers received the same type of breastfeeding consultation as described above.

#### *3.8.2.3 Second breastfeeding assessment and consultation (day 1)*

The sample mother-infant pairs who had not been able to establish latching-on had a second breastfeeding episode with consultation and assessment after being assigned to the intervention (skin-to-skin contact or not). The procedures for the breastfeeding

episode with consultation and assessment were similar to that of the first episode. Following this second breastfeeding episode, women were asked to fill in the self-rating scales once more.

#### *3.8.2.4 Breastfeeding procedures in the experimental group (skin-to-skin intervention)*

In the experimental group detailed advice was given to the each mother in the private hospital room about how to carry out skin-to-skin contact with the infant. This was followed immediately afterwards by new breastfeeding situation so that the mother and baby could “practice” the intervention procedure. The mother and infant were shown to the bed. The mother stretched out on the bed and received the baby clothed only in diaper, since the skin-to-skin procedure included that the naked upper body of the mother be in contact with the infant’s naked body. The infant was placed between the breasts of the reclining mother. If the mother felt cold, a blanket or sweater could be put on her shoulders to make her warmer or a little blanket could be put over the infant’s back. The mother was encouraged to allow the baby to crawl while holding a protective arm lightly over the baby: her arms could be supported by pillows. The mother was encouraged to talk and communicate with her infant if she liked. If the infant began to cry the mother was encouraged to comfort the infant as she saw fit, even if it meant sitting up to comfort her infant. Once the infant was calm again, she was encouraged to return to skin-to-skin contact in a reclined position.

#### *3.8.2.5 Breastfeeding procedures in the control group (no skin-to-skin intervention)*

In the control groups, each mother – infant pair was also met in a private hospital room equipped as above, although both mothers and infants were fully dressed at all times except when the mother’s breast was offered to the baby. The mother was usually positioned in common breastfeeding position sitting in the armchair holding the infant in front of the exposed breast. She was advised to start breastfeeding as she usually did. If the mother felt more comfortable lying down on the side she could do so. The mother was encouraged to allow the baby to move his/her head and arms freely. The mother’s arms could be supported with pillows. The mothers were encouraged to talk and communicate with her infant if she liked. If the infant began to cry the mother was encouraged to comfort the infant as she saw fit. Once the infant was calm again, she was encouraged to try breastfeeding again.

#### *3.8.2.6 Practise at home*

Mothers in both groups were instructed to go back home and begin to apply the knowledge they had gained during the second session of breastfeeding support. Mothers in the experimental group were free to use skin-to-skin as often as wanted when practicing breastfeeding. They were asked to document each time skin-to-skin was practiced. This first day of assessment and consultation could take between 1 ½ - 3 hours for sample mothers and infants. At this time, sample mothers made an appointment for a one week check-up.

#### *3.8.2.7 Breastfeeding check-up at 1 week*

At the one week check-up sample women had a breastfeeding consultation and assessment as described previously and questions about the breastfeeding situation were posed. This appointment was supportive in character and no specific data were collected. The check-up lasted between 1-1 ½ hours depending of the infant's behavior. If the baby cried or fussed, a short break was taken before continuing the procedures.

#### *3.8.2.8 Breastfeeding follow-up after 4 months*

At the four month appointment sample mother-infant pairs were again assessed during a breastfeeding episode with consultation and assessment. For this last follow-up, sample mothers who still were breastfeeding filled in the self-rating scales both before and after breastfeeding. As in the one week check-up, they were interviewed about the current feeding situation.

### 3.9 STATISTICAL ANALYSIS

Data are described and tested according to data level as follows:

Tables: Nominal data are presented as proportions. Ordinal data are presented as medians (md) and quartiles ( $Q_1$ ,  $Q_3$ ) and interval data are presented in means and standard deviation (SD) or standard error (SE).

Tests: For the nominal data differences between groups were tested with Chi-square tests (**II**, **III**, **IV**) and/or Fisher's exact test (**IV**).

Both ordinal data and interval data were tested with non parametric tests such as Mann-Whitney U test (**I-IV**) Wilcoxon signed rank-test and Chi-square test (**I**). For interval data parametric tests (t-tests) are used when appropriate.

In Study **I** the Mann-Whitney U test was used to test the differences in numbers of weeks of breastfeeding between the caesarean mother and the mother delivery with vaginal route.

In Study **II** the test was used to test the differences in the mothers perception of staff attitude between mothers choosing night rooming-in or not and in the difference in the four factors between mothers choosing night rooming-in or not. In Study **III** it was used to test differences in AF level between the experimental group and the control group. In study IV it was used to test the difference in time it took for the infant until regular suckling occur between the infants in experimental group and control group. In study I Wilcoxon signed rank-test was used to establish differences in blood pressure between two time points. In Study **III** permutation test was used to analyse differences in frequency of mastitis between groups.

In Study **IV** the Chi-square test was used for testing differences in the number of oxytocin and prolactin elevations between the groups. In Study **IV** t-tests were used to test the change in scoring of Emotional Breastfeeding Scale and Breastfeeding Physical Pain Scale between the mothers in experimental group and control group.

Correlations and Regressions: To assess correlations Spearman rank correlation coefficient ( $r_s$ ) was used for relating the number of oxytocin pulses to the duration of breastfeeding (**I**). Two simple regressions were used to study the relations between



times when suckling occurred regularly and number of skin to skin events and also between times when suckling occurred regularly and infant's age at inclusion (IV).

To find out the impact of different backgrounds and behavioural variables on the different patterns of oxytocin and prolactin, two explorative multiple logistic regression analyses were performed (I) and to summarize the combined effects of the background variables: parity, mothers' education, room size, and perceived staff attitudes, on the choice of rooming-in (II).

The attitude scale statements about mothers' attitude to night rooming-in and importance of closeness to the infant were grouped with exploratory factor analysis (II). The factors were initially extracted by principal component analysis, and orthogonal varimax rotation was then used. The number of factors retained was determined by the number of eigenvalues greater than one. The identified factors are linear combinations of related attitude scale variables. The coefficients of these linear combinations are called "factor loadings." To find a grouping of variables, we looked for coefficient sets with a "simple structure"; that is, related variables should have high loadings (coefficients) for the same factor and low loadings for the other factors (II). The Cronbach's alpha was used to measure internal consistency. Scores were computed for each factor by taking the mean of the item scores in the group of items belonging to the factor. These scores were compared between groups "rooming-in" or not rooming-in" illustrated by the box plot (II).

Multiple regressions were used to explore the relationship between the mean scores, *one multiple regression* for each factor (*in the attitude scale*) and background variables: parity, mothers' education, room size, and perceived staff attitudes (II).

P-value  $\leq 0.05$  was considered significant (I-IV). The program Stat View 5.0 was used for the statistical analyses presented in the results section (I-IV).

## 4 RESULTS

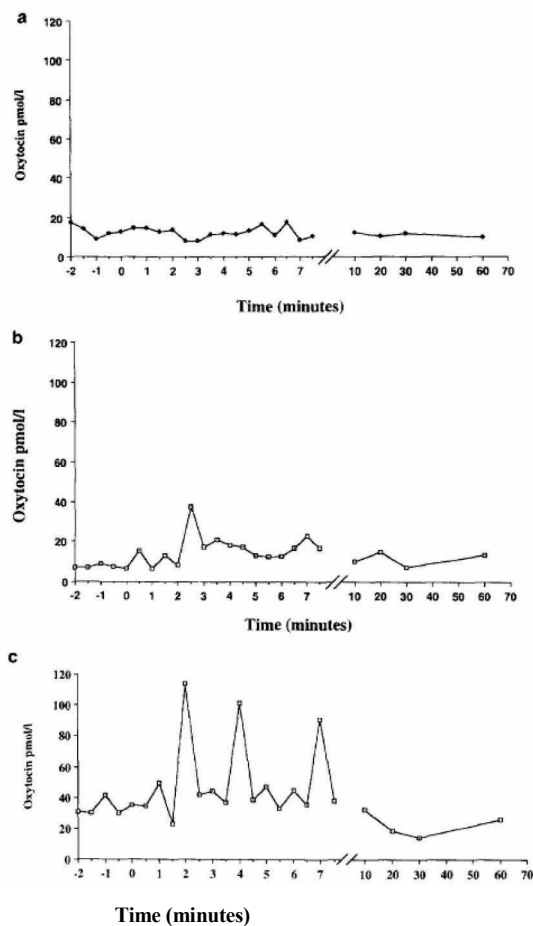
In the summery below only the most important result will be briefly presented for each study separately. For a detailed description, reference is made to original articles (I-IV).

### 4.1 STUDY I.

#### 4.1.1 Hormone levels and breastfeeding practices

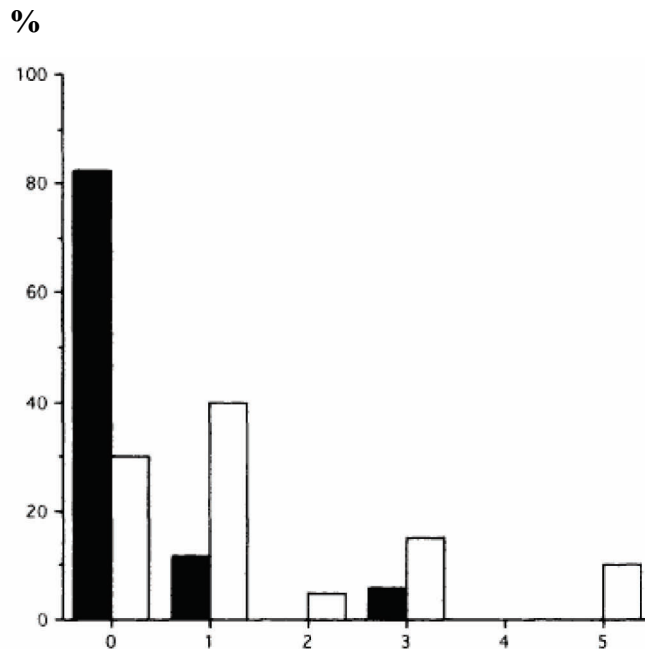
##### 4.1.1.1 Oxytocin

There were no significant effects on median oxytocin levels between the cesarean delivered mothers and vaginally delivered mothers following the onset of the observed breastfeeding during day 2. In contrast transient pulses of oxytocin occurred during breastfeeding when individual mothers were studied.



**Figure 7.** Oxytocin levels (pmol/l) in response to breastfeeding in individual women. (a) A women with emergency section. (b) and (c) Women with vaginal delivery. At “0” the infant started sucking the breast.

The PULSAR program was used to calculate the number of pulses for each mother during the breastfeeding and showed to range from 0 to 5. The distribution of oxytocin pulses are shown as relative frequency for mothers delivered by cesarean section and mothers delivered by the vaginal route in.



**Figure 9.** Distribution of oxytocin pulses in women delivery by cesarean section women (black) and vaginal delivery women (white). Relative frequencies. The x axis represents number of oxytocin pulses.

A multiple regression analyses showed that the number of *oxytocin peaks* were in order of significance explained by 1) mode of delivery ( $p = 0.0065$ ), 2) the age of infant at the first suckling ( $p = 0.022$ ) and 3) maternal somatic anxiety ( $p = 0.03$ ). These variables explained 49% of the variance. The variable epidural or spinal anesthesia did not significantly influence the oxytocin pattern.

In the group of vaginally delivering mothers the number of the *oxytocin peaks* during the first 10 minutes of the suckling start correlated positively with the time of exclusive breastfeeding ( $R_s = 0.65$ ,  $p = 0.006$ ). This relation was not found in mothers delivered by cesarean.

#### 4.1.1.2 Prolactin

Significantly more mothers in the vaginally delivered group showed a significant prolactin rise from 20 to 30 minutes after start of suckling than the group of mothers

delivered by cesarean. A regression analyses showed that 1) the duration of the studied breastfeeding session ( $p = 0.015$ ) and 2) the mode of delivery ( $p = 0.038$ ) were the only factors significantly affecting the rise in prolactin. The infant's postnatal age at the experiment and total number of breastfeeds preceding the experiment did not affecting the rise of prolactin.

#### 4.1.1.3 Cortisol

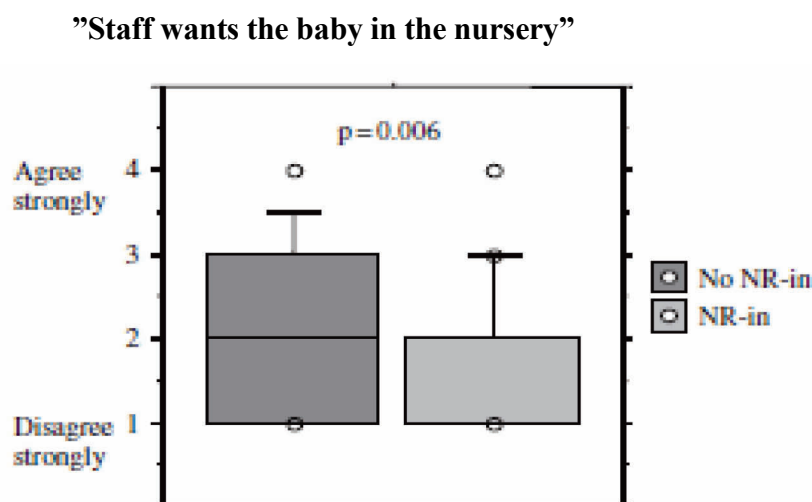
The mean levels of cortisol decreased significantly during breastfeeding in both cesarean delivered mothers ( $p = 0.004$ ) and vaginally delivered mothers ( $p = 0.002$ ) see Blood pressure

Blood pressure measured before breastfeeding and 60 min after suckling start showed a median significant fall in systolic blood pressure in vaginally delivered mothers ( $p = 0.025$ ), but not in mothers delivered by cesarean section ( $p = 0.062$ ).

## 4.2 STUDY II.

### 4.2.1 Mother's perceived staff attitude to night rooming-in

Of the 111 mothers participating in the study 58 (52%) roomed-in with the baby. Those 53 (48%) mothers *not* rooming-in perceived to a higher extent that the staff wanted their babies to stay in the nursery than mothers rooming-in with their babies ( $p = 0.006$ ).



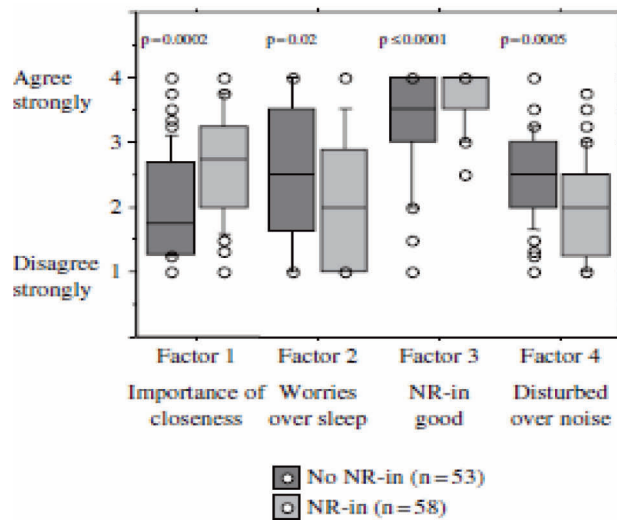
**Figure 10.** The mothers' perception of whether the staff wanted the baby in the nursery in relation to whether ( $n=58$ ) or not ( $n=53$ ) the mother roomed in with the baby (NR-in = night rooming-in).

#### 4.2.1.1 Variables possibly related to mothers' choice of night rooming-in

To see if reasons believed to affect mother's choice to rooming-in at night at the time of the study really did affect mothers' use of night rooming-in a logistic regression analysis was performed. The *dependent* variable was "rooming-in or not". The following four variables were used as *independent variables* 1) parity, 2) mother's education, 3) room size and 4) mothers' perceived staff attitude. It was found that in order of significance the following independent variables influenced the mother's choice to room in with her baby; perceived positive staff attitude ( $p = 0.003$ ), smaller room size ( $p = 0.01$ ) and higher maternal education ( $p = 0.03$ ). The degree of explanation was 27%. Parity did not significantly affect the mothers' choice to room-in ( $p = 0.41$ ).

Mothers attitudes according to the four identified factors in the Attitude Scale are shown in relation to the mothers' actual choice of rooming-in. Mothers who *did not room-in* with their babies found *closeness between mother and baby* less important ( $z = -3.780, p = 0.0002$ ), they *worried more about their own and the baby's sleep* ( $z = -2.321, p = 0.02$ ), they *found rooming-in worse* ( $z = -3.905, p = 0.0001$ ), and they indicated that they were *more disturbed by noise* ( $z = -3.487, p = 0.0005$ ) than mothers who roomed-in with the baby.

### “Attitude scale”



**Figure 11.** Mothers' median (quartiles) factor score in relation to rooming-in or not rooming-in: "Importance of mother-infant closeness" 2.750(2.000-3.250) vs 1.750 (1.271-2.688): "Worries about own and baby's need of sleep" 2.000 (1.000-2.875) vs 2.500 (1.625-3.500): "Night rooming-in: good" 4.000 (3.500-4.000) vs 3.500 (3.000-4.000): and "Sensitivity to disturbing noise": 2.000 (1.250-2.500) vs 2.500 (2.000-3.000) (NR-in = night rooming-in)

#### 4.2.1.2 Variables related to mothers' expressed attitudes towards night rooming-in

Further more, four multiple regression analyses were performed to clarify whether variables, such as parity, mothers' education, room size, and perceived staff attitudes, were related to mothers' expressed attitudes toward night rooming-in as measured by the attitude scale. The *four dependent* variables were the 4 factors (importance of closeness, worries about sleep, night rooming-in: good or bad, disturbed by noise) that were analyzed one at a time. The above-mentioned background variables and the perceived staff attitude were entered as *independent variables in each of the 4 multiple regressions*.

One independent variable, namely, mothers' perception about staff perceptions with respect to where the babies should sleep, was related to three dependent variables. Thus, the perception of staff wanting babies to stay in the nursery was predictive of low rating for factor 1, importance of closeness ( $t = 2.81$ ,  $p = 0.006$ ), factor 2, more worries about sleep ( $t = 3.56$ ,  $p = 0.0006$ ), and factor 4, more disturbed by noise ( $t = 1.88$ ,  $p = 0.06$ ). More multiparas than primiparas had a negative attitude toward night rooming-in (70% vs 30%,  $\chi^2 = 4.69$ ,  $p = 0.05$ ).

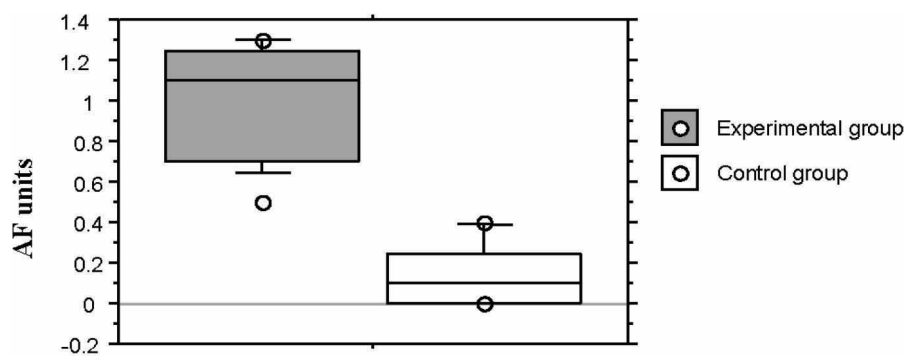
### 4.3 STUDY III.

#### 4.3.1 Content of AF in milk samples

There was a significant difference in the median levels of AF between the experimental ( $n = 12$ ) and control groups ( $n = 16$ ): 1.1 (0.7–1.25) units vs 0.1 (0.0–0.25) units,  $Z = -4.492$ ,  $p = 0.0001$  (Figure 10).

##### 4.3.1.1 Frequency of mastitis in relation to AF levels

Under the study period one mother in the experimental group was diagnosed with mastitis versus six in the control group. Three of those in the control group had mastitis twice and one had mastitis three times ( $p = 0.0086$ , permutation test). The mother in the experimental group who had mastitis had eaten cereals only 5 days per week. Misunderstanding the instructions, she did not eat them on weekends.



**Figure 12.** Box plot showing levels of AF units in the experimental ( $n = 12$ ) and control groups ( $n = 16$ ).

When comparing the median AF levels in mothers with or without mastitis, there was a significant difference: 0.0 (0.0–0.1) vs 0.5 (0.2–1.1),  $Z = -2.399$ ,  $p = 0.017$ .

The mother in the experimental group who got mastitis and had eaten the HPC/SPC only 5 days per week had an AF level of 0.5, which was the lowest level among the mothers in that group.

##### 4.3.1.2 Mastitis

All mothers who had mastitis had fever  $>38.4^{\circ}\text{C}$ . Although no culture was done, one mother was clinically diagnosed with an infected mastitis as she had had nipples with sores that did not heal during the weeks preceding the mastitis. She was treated with

antibiotics. The other mothers breastfed partly. The two mothers in the control group who breastfed partly got mastitis. Their AF levels were 0.1 and 0.0, respectively.

## 4.4 STUDY IV

### 4.4.1.1 Background data the first visit

There was no difference between the experimental group (skin-to-skin treatment) and the control group (no skin-to-skin treatment) in hospital routine data.

**Table 2.** Hospital routine data are shown for mothers and infants in the experimental ( $n=53$ ) and control group ( $n=50$ ) according to medical records.

	Experimental group	Control group
Care routine/interventions	No. (%)	No. (%)
Oxygen post partum p.p*.	14 (28)	10 (20)
Suctioning mouth/ventricle p.p.	19 (39)	16 (34)
No separation first hour p.p	28 (55)	28 (58)
Breastfeeding/attempt $\leq 2$ hour p.p.	16 (31)	19 (40)
<b>Supplementary feeding</b>		
with formula	42 (84)	39 (78)
<b>Supplement days</b> Md ( $Q_{1,3}$ )	2(0-4)	2(0-3)
<b>Reason for supplement feeding</b>		
Medical reason	29 (58)	24 (48)
No reason given	13 (26)	15 (30)
<b>Infant</b>		
<b>Complications first days p.p.**</b>		
Hypoglycemia	14 (27)	14 (29)
Ickterus	11 (22)	12 (24)
Weight loss $\leq 10$	8 (16)	8 (16)
Blocked/obstructed nose/ breathing	2 (4)	3 (6)
Swollen tongue	1 (2)	0 (0)
Occasional vomiting first days	19 (44)	13 (31)
Ankyloglossia	0 (0)	2 (4)
<b>Noted “physical problems” in the record</b>		
<b>Mothers</b>		
Breast/nipple status at delivery and maternity ward		
- wound or/and severe nipple pain	7 (15)	7 (15)
- inverted, flat nipple	16 (32)	24 (51)
- breast reduction	3 (6)	3 (6)
<b>“Hands-on latch intervention” during hospital stay</b>		
-yes	43 (93)	44 (96)
-no	3 (7)	2 (4)
<b>Maternity stay, (hour) Md (<math>Q_{1,3}</math>)</b>	120(102-141)	114(84-135)

\*Post partum \*\*Some infants had one or more complications

The mothers’ experiences of “hands-on latch intervention” are shown in table 3.



**Table 3.** Mothers experience of “hands-on latch intervention”

Mothers experience of “hands-on“	Number of mothers Total exp/cont	
“Hands-on” not hard: ”not painful” “I didn’t know anything else” “unpleasant” “stressful”.	38	19/19
”Hands-on” hard: ”squeeze and pulling hard” ”painful” ”violent” ”humiliating” ”forceful” “heavy handed” “lasting bruises”	49	24/25
Did not receive “hands-on” intervention	5	3/2
Not noted	11	7 /4
<b>Total</b>	<b>103</b>	<b>53/50</b>

#### 4.4.2 Effects in relation to the intervention

##### 4.4.2.1 Breastfeeding Emotional Scale and Physical Pain Scale immediately before first breastfeeding attempt and during the second breastfeeding attempts

Analyses of the self-rating scales administered prior to the first breastfeeding episode also indicated that there were no significant differences between the experimental and control group in mothers’ mean score on either the Breastfeeding Emotional Scale (mean 58, SE 1.850 vs. mean 56, SE 2.232, p-value = 0.470) or the Breastfeeding Physical Pain Scale (mean 2,5, SE 0.276 vs. mean 2,3, SE 0.284, p-value = 0.632) before first breastfeeding episode. However, for sample mothers, analyses after the second breastfeeding episode on day 1 did indicate some significant differences. The level of the mean scores on the Breastfeeding Emotional Scale assessed during breastfeeding was significantly higher in the experimental group than in the control group (mean 69, SE 1.680 vs. mean 62, SE 2.443, p-value = 0.022). Furthermore, experimental group mothers assessed mean pain score fell significantly during this second breastfeeding episode from 2.5, SE 0.276 to 1.8, SE 0.233 (p value = 0.004). The control group mothers estimated mean pain score during the second breastfeeding episode did not fall significantly.

##### 4.4.2.2 Number of infants latching-on regularly

The proportion of infants starting to latch-on and suckle did not differ significantly between the experimental group 75% (n=40), and control group 86 % (n=43) (Fisher’s Exact test  $p = 0.217$ ).

#### 4.4.2.3 Time from randomization to regular latching

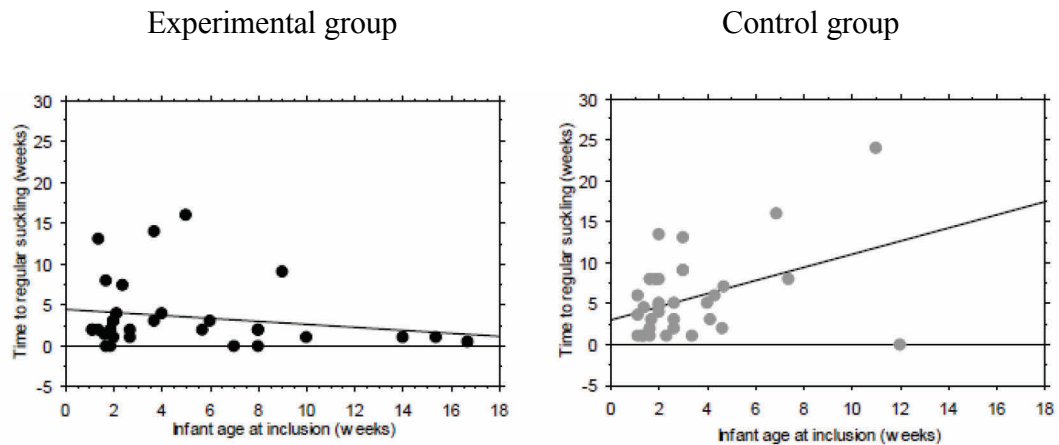
The infants in the experimental group (n=31) began to latch-on and suckle regularly in a significantly shorter *median* time than the infants in the control group (n=33); median 2.0 weeks ( $Q_1=1.0$ ,  $Q_3=3.7$ ) vs. median 4.7 weeks ( $Q_1=2.0$ ,  $Q_3=8.0$ ), (Tied Z-value = -2.324,  $p = 0.020$ ). When *looking at the distribution* of weeks the infants spent before regular suckling it is noted that 23 infants out of 31 (74%) in the experimental group started to suckle within three weeks versus 13 infants out of 33 (39%) in the control group (Fisher's Exact test  $p = 0.006$ ). When trying to find a possible reason for this difference in distribution of weeks of suckling start, it was found that in the experimental group 94% of the infants starting to suckle within three weeks had a history of "strong reaction" during "hands-on latch intervention" compared to 33% of the infants in the control group (Fisher's Exact test  $p = 0.0001$ ), although similar amount of infants in both groups had shown "strong reaction" to the "hands-on latch intervention" (Table 3b).

**Table 4.** Examples of expressions used by mothers to describe of the infant's reaction on "hands-on latch intervention"

Mothers descriptions of infants reaction on "hands-on"	Number of infants	
	Total	exp/cont
<b>Passive reaction</b> "no reaction" "passive" "fell asleep" "didn't care" "not interested" "bored" "turned off"	20	11/9
<b>Strong reaction</b> "screaming" "became hysterical" "was defensive" "avoidant" "sad" "panicked" "worried" "mad" "angry"	62	30/32
<b>Suckled temporarily</b>	1	0/1
<b>Did not receive hands-on intervention</b>	5	3/2
<b>Not noted</b>	15	9/6
<b>Total</b>	103	53/50

#### 4.4.2.4 Infants age in relation to time for suckling

To illustrate if age of the infants at inclusion was related to time it took to establish regular suckling a regression was preformed. It was found that in the control group the infant age at inclusion correlated positively and significantly with the time it took to establish regular suckling ( $R = 0.409$ ,  $p = 0.018$ ,  $R^2 = 0.167$ ) in the experimental group there was no significant correlation ( $R = 0.192$ ,  $p = 0.300$ ,  $R^2 = 0.037$ ).



**Figure 13.** Descriptive regression plot for experimental and control groups showing infants age in weeks at inclusion and time in weeks it took to established regular suckling.

#### 4.4.2.5 Mother's response to infant's starting latching-on

There was no significant difference between the experimental group (n=40) and control group (n=43) in numbers of mothers who started to breastfeed after the infants started to latch-on. Of the mothers starting to breastfed approximately 60% of the mothers in both groups started to breastfeed exclusively.

### 4.4.3 Four months after inclusion

#### 4.4.3.1 Breastfeeding

Four months after the intervention 55% of the mothers in the experimental group (n=29) and 54 % of the mothers in the control group (n=27) were still breastfeeding (NS).

Infant age when entering the study did not significantly affect if mothers breastfed or not 4 months after the intervention ( $H=3.791$ , Tied  $p = 0.149$ ).

The median *age* of the infants when starting latching-on regularly and started to breastfeed was 7.7 weeks, ( $Q_1=3.7$ ,  $Q_3=10.7$ ) in the experimental group vs. 7.1 weeks, in the control group ( $Q_1=4.6$ ,  $Q_3=11.7$ ). This difference was not significant. (Tied Z-value = -0.101,  $p = 0.919$ )

#### 4.4.3.2 *Breastfeeding Emotional Scale*

At four months after inclusion, mothers who were still breastfeeding (experimental group, n=21, control group, n=20) filled in the Breastfeeding Emotional Scale once more before and during breastfeeding. There was no significant difference within or between the groups in the mean scores neither before (73, SE 2.054 experimental group) vs. (75, SE 2.731 control group) or during breastfeeding (72 SE, 2.656 experimental group) vs. (75 SE, 2.600 control group).

## 5 DISCUSSION

### 5.1 MAIN RESULTS IN THIS THESIS

Mode of delivery and infant's age at first breastfeed were found to be the most important independent variables for a development of an early pulsatile oxytocin pattern of importance for breastfeeding as measured on day 2 (I). Mothers who did not room-in with their babies were more likely to have perceived that the staff believed their babies should stay in the nursery compared with those mothers who roomed in with their baby. In addition, those mothers not rooming-in with their babies scored closeness to their babies as less important than those mothers who roomed-in with their babies (II). The frequency of mastitis in a group of mothers randomized to eat a specially prepared cereal with anti-secretory factor (AF) inducing properties, had significantly reduced incidences of mastitis compared to a control group not eating the AF inducing cereal. The median AF levels were significantly higher in mothers without mastitis. No mother with an AF level above 0,5 units had mastitis (III).

Infants with latch-on problems weeks or months after birth, who started to latch-on after being randomized to skin-to-skin-treatment during breastfeeding, spent a significantly shorter median time before latching-on than a control group. Mothers to infants staying skin-to-skin during breastfeeding scored more positive feelings towards breastfeeding than control mothers (IV).

### 5.2 METHODOLOGICAL CONSIDERATIONS

The time of data collection for the different studies in this thesis has a range from 1990 to 2003. Data in Study I are of biochemical and physiological type. They are still valid and of interest to be used together with later findings regarding oxytocin and clinical phenomena during breastfeeding. Even if rooming-in (II) is a routine at all Swedish hospitals today many hospitals in other parts of the world separate mothers from their babies soon after birth and leave the baby in a nursery. An indication of the actuality of the study is that researchers from other parts of the world recently have asked for permission to use the Night Rooming-in Attitude Scale (II) in their research. In addition, there is an important message to be found in this study; the mothers choosing rooming in understand and “read” staff’s more or less explicit opinions, which may

even be expressed by body language; The mothers act as if they believe what the staff wants them to do.

Below some factors concerning biases are discussed: the so-called Hawthorne effect (**I**) and effects whether researchers are blinded to the randomization (**II**) or not (**IV**).

It could be speculated whether the unexpected approximately similar length of exclusive breastfeeding between mothers who delivered by the vaginal route or cesarean section (**I**) could be caused by the so-called Hawthorne effect. The cesarean mothers may have been positively stimulated to breastfeed by the calm and professional way they were treated during the breastfeeding and blood-sampling episode than cesarean mothers in general were supported by. However, the vaginally delivered mothers had the same person and the same type of setting during their episode of blood sampling during breastfeeding. In conclusion the effect of the investigator may have had the same effect on both groups of mothers. But in the cesarean group of mothers the effect of the researcher may have over-ruled the lack of oxytocin pulses and prolactin increments seen in the vaginally delivered mothers.

The sample size in Study **I** was based on experience from previous studies on hormonal changes in breastfeeding women.

Study **II** is a descriptive study of mothers' choice to room in with their baby or not. Data were collected during two weeks. About 100 mothers were expected to fulfill the criteria during this time. This number was believed to be enough to do the planned factor analysis of the attitude scale (Gourch 1983). At the time of the study we estimated that 40% - 60% of the mothers had their infants in their room during the night and the remaining mothers left the infant in the nursery.

The sample size in Study **III** was small. The reason for this was that the analyses of anti-secretory factor (AF) were of biological character and complicated and costly to perform. The size of the sample was calculated on the chance to inducing anti-secretory factor (AF) in mothers' milk or not by intake of specially treated cereals (SPC). With 15 mothers in each group, a difference between 5% and 45% can be detected with a power of 0.80. Unfortunately, more mothers in the experimental group did not fulfill the intake of the SPC, some because they did not like the taste of the cereal. However, this could not be a bias of the study. The cereals were randomized blindly to the

researcher of the study, both the person performing the study clinically and the person doing the analyses. Thus, when a mother informed that she had stopped taking the cereal it was hidden to the researchers if the mother belonged to experimental or control group. The code was broken when all AF-analyses were done. Instead, the finding that no mothers with AF level above 0,5 units developed mastitis is an evidence for the protective effect of anti-secretory factor. It is interesting to note that the only mother in the experimental group who developed mastitis was the one with the lowest AF level in this group. She misunderstood the prescription and did not eat the cereal during Saturdays and Sundays, which probably caused her to have the lowest level of AF (0,5 units) in the experimental group. This may indicate that there is a protective level of AF level above 0.5 units. This level has been shown to be the level reducing diarrheal diseases in animal offspring (Lange and Lönnroth 2001). In conclusion, when assessing the protection capacity of AF against mastitis it should be taken into account there is a “dose dependency” relation between the level of AF in maternal milk and having or not having mastitis. This strengthens the hypothesis that AF is protective against mastitis even in humans. Further studies need to confirm the results from Study III.

All mothers in Study IV had been seeking help for the infants’ difficulty to latch-on to the breast at maternity units, well baby clinics and/or breastfeeding out patient’s clinics. Within one screening visit, the two investigators in this study solved the sucking problems in 127 of the 230 mother- infant pairs. This implies that the standardized model to guide mothers was remarkably well adapted to the mother’s breastfeeding problem. It also implies the two investigators’ high ambition to relieve as many mothers as possible from breastfeeding problems. The same standardized model for breastfeeding counselling was used in both the experimental and control group. The inter-researcher reliability was tested and found be high (Gustavsson A, 2006).

The stability of this model for breastfeeding counselling was supported by the fact that approximately the same number of infants started to suckle in both experimental and control groups, even when controlling for hospital/midwife. In addition to this standardized model for counselling, skin-to-skin contact between mother and infant added some important factors, as the infants in the skin-to-skin group started to suckle regularly after a significantly shorter median time than the infants in the control group.

## 5.3 DISCUSSION OF RESULTS

### 5.3.1.1 *Delivery room practices and start of breastfeeding*

As there seems to be clinical practices around child birth that are beneficial for early milk production it is important to find more theoretical support for the role of different practices in this respect.

A question often raised is what is causing the difference in breastfeeding ability in mothers giving birth by the vaginal rout and mothers giving birth by cesarean section. What is undermining the cesarean mother's breastfeeding? They often have less milk (Evan et al. 2003), their babies are given supplementary feeds more often and they have more breastfeeding problems (Carvalhaes et al 2003). They are more associated with frequent partial breastfeeding (Häggkvist et al. 2010). Is it the skin-to-skin contact and/or early suckling that support breastfeeding after a giving birth vaginally? Or is it the type of anesthesia given to the mothers that is the reason for breastfeeding problems?

### 5.3.1.2 *Oxytocin pulsatility and breastfeeding accomplishment*

In Study I it was found in a regression analyze that variables affecting oxytocin pulsatility measured on day 2 after delivery were in order of significance: 1) mode of delivery, 2) age of the infant at the first suckle and 3) maternal somatic anxiety. According to this analysis epidural or spinal anesthesia did not affect the oxytocin pulsatility significantly the first ten minutes after start of a breastfeeding.

The vaginally delivered infants in Study I were all left skin-to-skin with the mother and were also those suckling early, i.e. within the first 2 hours after birth. Their mothers had significantly more oxytocin pulses during the first 10 minutes of a breastfeed on day 2 than the mothers delivering by cesarean section with no skin-to-skin contact and no early suckling. It was found that the number of oxytocin pulses the first 10 minutes after onset of suckling correlated positively and significantly with the amount of milk ingested by the infant on day 2 (Nissen et al 1998), as well as to the period of time of exclusive breastfeeding (I).



The mothers giving birth by cesarean section had hardly any oxytocin pulses and there was consequently no correlation between pulses and milk amount ingested by the infant and time of exclusive breastfeeding.

In the study by Bystrova et al (2007), where no mother was given EDA or gave birth by cesarean section, it was found that skin-to-skin per se did not contribute significantly to amount of milk ingested by the infant on day 4. Early suckling within 2 hours was the main factor contributing to milk amount in both primi- and multiparous women. In addition, the amount of milk ingested by the infant correlated to the time of “nearly exclusive” breastfeeding.

Matthiesen et al (2001) have shown that the newborn infant’s hand massage of the mother’s breast during skin-to-skin contact *before suckling* increases circulating oxytocin in correlation to the intensity of the hand massage. Thus, the more massage the higher oxytocin levels, the less massage the lower levels of oxytocin. A pulsatile pattern of oxytocin with multiple peaks seen during breastfeeding does not occur during skin-to-skin contact before suckling.

In summery; early skin-to-skin contact per se does not seem to add anything to milk amount (Bystrova et al 2007)), where oxytocin pulses are not likely to occur during skin-to-skin contact *before suckling* (Matthiesen et al 2001). Infants to vaginally delivered mothers suckled early and their mothers had a pulsatile oxytocin pattern day 2 after delivery, which was not the case in mothers after cesarean section (Nissen et al 1998). The number of oxytocin pulses correlated to milk amount on day 2 as well as to time for exclusive breastfeeding. We hypothesize that these data together indicate that early suckling may be the main catalyst of inducing early oxytocin pulsatility.

Armstrong & Hutton (2006), Theodosis et al (2006), Catheline et al (2006) and Handlin (2011) describe that the oxytocin secreting neurons undergo morphological changes whenever they are strongly stimulated. The glial cells around the oxytocin neurons retract. This result in extensive dendritic bundling, which may facilitate electronic coupling by synchronizing oxytocin neuronal firing during milk ejection bursts.

The first hour post partum is a period with high oxytocin levels (Nissen et al 1995). Thus, the prerequisite for retraction of the glial cells is fulfilled so the oxytocin can be released from its cells where it is produced as the first suckling occurs. Thus, only 3 of 17 cesarean mothers in Study I who had infants who suckled for the first time at a

median of 4 hours after birth showed oxytocin pulses. The healthy infants' spontaneous suckling of the breast around one hour after birth is apparently a vigorous sensory stimulus, which may be of importance for the removal of colostrum and initiation and optimization of the milk production and milk ejection systems. Interestingly, even multiparous women who have been breastfeeding earlier children are dependent on early suckling to produce optimal amounts of breast milk the first days after giving birth once more (Bystrova et al 2007).

Thus, mother and infant are equipped with parallel biological systems: the infant's competence to search the breast and start suckling around an hour after birth, but normally not after four hours, coincides with the time the mother's breast is notably sensitive to stimuli which optimizes lactation.

#### *5.3.1.3 Cesarean section and breastfeeding*

The main reason for increased breastfeeding problems after cesarean section (**I**) may be the lack of early suckling as a consequence of separation of mother and infant soon after birth (see above).

An additional reason for the impaired breastfeeding is the cesarean section per se; Surgery destroys skin, several muscular layers, adipose tissue and vessels causing notably pain, physiological stress and somatic anxiety according to various psychological rating scales. Mothers giving birth through cesarean section also showed more "somatic anxiety" on a self-rating scale than those giving birth through the vaginal route. Stress is known to cause breastfeeding problems. Stress hinders oxytocin release and milk ejection (Newton & Newton, 1948). If milk is not released this is followed by lower milk production. Mothers who delivered by cesarean section (**I**) were also those with few oxytocin pulses and with no prolactin increments in serum during breastfeeding.

Interestingly, there was no significant difference in length of time for exclusive breastfeeding between mothers delivering by cesarean and the vaginal route. Evans et. al. (2002) found that mothers delivering by cesarean section had less milk on day two than mothers delivered by the vaginal route. Surprisingly, on day 5 the two groups of mothers in Evan's study had about the same amount of milk. The reason for this could be that no infant was given formula during these studied 5 days and the infants suckled

the breast whenever they wanted which may have increased the milk supply sufficiently. Frequent suckling is known to increase the amount of breast milk ingested by the infant (Salaryia 1978, Nylander et al 1991, Bystrova 2007). The mothers giving birth after cesarean section (**I**) could possibly have increased their breastfeeding frequency and increased their milk production early, thereby managing to catch up with those mothers who had been vaginally delivered, so that in both groups the approximate length of time for exclusive breastfeeding became similar.

The impaired secretion of oxytocin and prolactin and less milk ingested by the infants to cesarean mothers' day 2 (**I**) indicate the importance of early skin-to-skin contact between mother and infant, early suckling, frequent suckling and the avoidance of supplementary feeds to the healthy full term infant.

#### *5.3.1.4 Effect of skin-to-skin contact on breastfeeding*

##### **Mother**

The clinical practice to give the baby to the mother immediately after birth, to stay naked in her arms during the first hour seems to have an additional beneficial effect for breastfeeding success (**I**). The vaginally delivered mothers scored lower in "somatic anxiety" day 2 after delivery than the mothers who had been separated from their infants the first hours after a cesarean birth. To have the baby skin-to-skin during breastfeeding as shown in Study **IV** seems to improve the mother's perception of breastfeeding. Thus, the group of mothers having the baby skin-to-skin during breastfeeding scored significantly higher on the Breastfeeding Emotional Scale during breastfeeding, compared with mothers breastfeeding without skin-to-skin contact. This may be a sign of relaxation, less frustration and less anxiety in the mothers while experiencing skin-to-skin contact with their baby. These results indicate that mothers enjoy breastfeeding more during skin-to-skin contact than without skin-to-skin contact.

In addition, mothers in Study **IV** having skin-to-skin contact during breastfeeding scored lower on the Physical Pain Scale than the mothers without skin-to-skin contact during breastfeeding. The latter could be an indication of a pain relieving effect of the release of oxytocin during skin-to-skin contact and breastfeeding. In animal experiments oxytocin has been shown to be pain relieving (Lundeberg et al. 1994, Uvnäs-Moberg et al. 1992).

## Infants

All infants in Study **IV** were diagnosed with a problem to latch-on to the mother's breast and breastfeed. Many of them but not all had been exposed to complications around birth as well as to medical treatments and separation from the mother (see Table 2). They were from 6 days to approximately 4 months old. Almost all of the infants (95%) had been subjected to "hands-on latch intervention" by staff. This intervention includes holding the mother's breast with one hand and the infant's head with the other hand while trying to attach the infant to the breast. This sometimes forceful procedure does not always allow the infant to lick the areola and nipple into shape and to perform the inborn rooting and tongue reflex before attachment. In Study **IV** infants with severe latch-on problems were randomly assigned to skin-to-skin contact with the mother during breastfeeding or not. Approximately the same percentage of infants in both groups started to latch on. However, in the skin-to-skin group the infants learnt to latch-on within a significantly shorter time. Surprisingly, the infants who had shown "strong reaction" to hands-on latch intervention" started to latch on within 3 weeks. This was not the case in the group of infants belonging to the control group.

The interpretation is that the skin-to-skin contact with the mother induced calmness in the infant. Bystrova et al. (2003) have suggested that skin-to-skin early after birth decreases the negative effects of "the stress of being born". It is likely that skin-to-skin contact with the mother even in these older infants will counteract "the stress of being forced to breastfeed". Skin-to-skin contact may relieve the memory of stress and possible experienced "suffocation" in those infants who were forced to the breast by a heavy-handed person. With skin-to-skin contact, the infant can relax, stop crying and maintain enough calm to successively, and successfully, co-ordinate body movements with the five senses (sight, touch, hearing, smell and taste) to achieve the latch and suckle, echoing the patterns of a normal newborn during the first hours of life (Widström et al 2010).

Thus, infants in the skin-to-skin group may regain the inborn program to find the mother's breast, get acquainted with the breast by licking and touching in their own way while being able to move freely on the mother's chest. It is suggested that during this process the infant develops the rooting reflex as well as the reflex to concomitantly put the tongue in the bottom of the mouth (Widström and Thingström-Paulsson, 1993)

in order to be able to catch to the breast with a wide opened mouth and start suckling. This assumption is supported by a study where it was shown that significantly more infants among those who had skin-to-skin contact for at least one hour after birth were sucking correctly compared with infants who had been separated after 20 minutes and then returned clothed to the maternal breast after finishing with hospital care routines, such as being weighed, washed etc. (Righard et al. 1990).

Interestingly, it has previously been found that infants who remained skin-to-skin with their mother one and a half hours after birth had more optimal self-regulation one year later than infants who were separated from their mothers and placed in the nursery during the same length of time (Bystrova et al 2009). It is possible that the skin-to-skin sessions with the mother even helped the older infants (IV) to successively achieve more optimal self-regulation. This may have helped the infant to control the breast-feeding situation.

#### *5.3.1.5 Continuation of closeness between mother and infant at the maternity*

At the time of Study II mothers had an option to keep the baby in her room or leave the baby in the nursery at night. During this period, staff and mothers in our hospital were discussing the merits of mothers and babies spending the night together. Multiparous women seemed to be more reluctant to keep their babies in their rooms. In general, some people thought that mothers “should rest” from the baby, whereas others considered it important for mothers and babies to stay together 24 hours a day, since this practice would improve their relationship and allow them to sleep better. Another opinion that was generally held by the staff at that time was that mothers did not want to room-in with the baby, since it would mean too many mothers and babies in the same room, resulting in too much noise. However, if the baby stayed with the mother during the night, the baby would feed from the breast more often instead of being at risk for being fed formula by the staff. It has been shown that if a healthy breastfed infant is given formula in between breastfeeds this suppresses the amount of breast milk ingested by the infant. In fact, when comparing a group of healthy infants staying in the nursery in between breastfeeds with a group of healthy infants rooming in with their mothers the total volume of liquid intake on day 4 after delivery was about the same in the two groups. However, only 65% of the volume ingested by the infants staying in the nursery was breast milk the rest was formula given by staff (Bystrova et al 2007).

Mothers who left their babies in the nursery at night were more likely to perceive that staff indeed believed their babies should be there. The reason for this may be that new mothers tended to adapt to hospital routines, as we know from clinical practice. In addition, another study showed that newly delivered breastfeeding women score higher in the personality trait indicating improved “social desirability” i.e., a person’s disposition to respond in a socially desirable way, than a control group of non-breastfeeding women (Uvnäs-Moberg et al. 1990a). However, the most remarkable aspect was that those mothers not rooming-in with their babies scored closeness to their babies as less important than those mothers who roomed-in with their babies. Today in Sweden, all mothers do room-in with their babies. Partners to the mothers are also encouraged to the hospital as much as possible so that the new family can get to know each other.

Today there is another trend in the care of the baby and the new family that is alarming. There is a tendency to take the baby away from the mother after a minimum time of skin-to-skin contact. The baby may be in the middle of proceeding through the stages of the inborn program to reach the breast. A sudden interruption will probably make the baby start to cry. The implicit message from staff to the parents may be that closeness is not important and that there is no need to adapt the care to the baby’s behavior. Thus, the baby’s needs and the parents’ possibility to see and understanding those needs and appreciate the competence of the newborn infant are not taken into account.

One can be speculated on if mothers in Study II would have left their infants in the nursery if they had experienced uninterrupted skin-to-skin contact with their babies during the first hours after birth. We believe that if parents and staff, at the time the studies were conducted, would have been more aware of the importance of the newborn infant’s instinctive behavior the infants would probably have been left with the mother after cesarean birth, roomed-in with her, and subsequently may have had less latching on problems.

### *Mastitis*

Another negative effect of separation and low breastfeeding frequency is the increased risk for mastitis. Not being in intimate proximity to the baby or not being able to read the baby’s signals for hunger is an additional risk for developing mastitis. It is also easy to sooth the baby by putting a pacifier in the baby’s mouth. Unintentionally, this will

60

increase the time between breastfeeds. Then milk is not emptied from the breasts. The pressure in the breasts will increase, resulting in the potential risk for mastitis. Since mastitis is an illness where mothers feel very ill and exhausted, they will have problems caring for the newborn baby. Thus, it is important to prevent mothers from developing mastitis.

In clinical practice the SPC has been shown to relieve mothers from repeated mastitis. Those mothers with repeated mastitis have described of their relief from exhaustion and illness after having eaten the SPC.

## 6 IMPLICATIONS FOR FUTURE CLINICAL PRACTICES

- Place the baby skin-to-skin with the mother immediately after birth the first hours of life
- Let the baby stay skin-to-skin with the mother to peacefully and undisturbed go through the nine developing stages Birth cry, Relaxation, Awakening, Activity, Resting, Crawling, Familiarization, Suckling and Sleeping. During this procedure the baby develops the rooting-tongue reflex and is capable to attach to the breast by him or herself. Early suckling is hypothesized to be the main catalyst for inducing early oxytocin pulsatility. More oxytocin pulses were related to more milk and longer exclusive breastfeeding.
- Refrain from helping the baby to the breast with “hands-on latch intervention”. This force may disturb the baby’s rooting-tongue reflex and cause aversion to the breast and latch problems.
- Be aware of that new mothers are sensitive to messages maybe given unknowingly in words or by body language and act as they believe is wanted.
- When a mother has recurrent mastitis it may be considered to suggest her to have cereal with AF inducing properties.



## 7 ABSTRACT IN SWEDISH - SVENSK SAMMANFATTNING

**Det övergripande syftet** med avhandlingen var att undersöka vilka förlossnings- och BB rutiner som kan underlätta amning och vilka som kan vara hindrande för amning,

**De specifika syftena** var undersöka 1) amningshormoner hos kvinnor som fött vaginalt och med kejsarsnitt 2) i vilken utsträckning mammorna hade barnen hos sig på natten på BB och vilka attityder mammorna hade till att ha barnet hos sig på natten 3) om anti-sekretorisk faktor (AF), som förebygger mastit hos grisar, kan stimuleras i modersmjölk 4) om hud-mot-hud kontakt mellan mamma och barn under amningsförsök kan avhjälpa sugsvårigheter hos lite ”äldre” barn.

### **Metoder och resultat:**

Studie **I**; Blodprov samlades in från tjugo mammor med normal vaginal förlossning (VD) och 17 mammor med akut kejsarsnitt (CS) under ett amningstillfälle dag 2 efter förlossningen och analyserades för oxytocin, prolaktin och kortisol. De vaginalförlösta mödrarna hade signifikant fler oxytocinpeakar än mödrar förlösta med kejsarsnitt. Hos kvinnor förlösta med kejsarsnitt skedde ingen prolaktinökning under amningstillfället. Förlossningsätt, barnets ålder vid den första amningen och oro hos mamman påverkade antalen oxytocinpulsar.

Studie **II**: Etthundraelva mödrar svarade på en enkät om vad de tyckte om att ha barnet hos sig på natten under BB-vistelsen (1990). Mödrar som lämnade sina barn i barnsalen på natten var mer benägna att göra så om de uppfattade att personalen tyckte att deras barn ska vara där. Mödrar som inte hade barnen hos sig på natten betonade vikten av närhet till barnet som mindre viktigt än mammor som hade sina barn hos sig.

Studie **III**: 40 mammor randomiserades till att antingen äta specialprocessat havre (SPC) eller vanligt havre (placebo). Efter 4-5-veckor undersöktes AF-faktorn i mammornas mjölk med en biologisk metod. Medianvärdet på AF-nivån i försöksgruppen (n = 12) och i kontrollgruppen (n = 16) skilde sig signifikant åt mellan grupperna: 1,1 (0,7 till 1,25) enheter jämfört med 0,1 (0,0-0,5) enheter (p = 0,0001). Frekvensen av mastit minskade i försöksgruppen jämfört med kontrollgruppen (p-värde = 0,0086). AF- nivåerna skilde sig signifikant mellan kvinnor med och utan mastit (p = 0,017).

Studie **IV**: Etthundratre mammor med barn som hade sugproblem randomiserades till hud -mot hud-kontakt (försöksgruppen) eller ingen hud-mot- hudkontakt under amning (kontrollgrupp). Mödrar i försöksgruppen skattade signifikant högre positiva känslor under amning än mödrar i kontrollgruppen. Ungefär samma procentandel av barn i båda grupperna började suga på bröstet. Barn i försöksgruppen (n=31) började suga utan problem efter i meeltal två veckor, medan det för barn i kontrollgruppen (n=33) tog drygt fyra veckor (p-värde = 0,02). De flesta barn (94%) i försöksgruppen som började suga inom 3 veckor hade tidigare reagerat starkt negativt vid amningstillfällen när personal försökt hjälpa till ”handgripligt” för att få barnet att suga, motsvarande siffra för kontrollgruppen var 33% (p = 0,0001).

**Slutsatser:** Tidig amning, inom 2 timmar efter förlossningen, förefaller vara den viktigaste faktorn för att tidigt framkalla oxytocinpike i moderns blod. Spädbarn bör ha möjlighet att stanna hos modern med hud –mot- hudkontakt under de första timmarna efter förlossningen, för att få möjlighet att gå igenom det ”biologiska programmet”, utveckla amningsreflexer och börja amma när han eller hon är redo. Nyfödda barn med sugsvårigheter som kan ha orsakats av ”handgriplig hjälp” från personal, tycks kunna återskapa de störda amningsreflexerna, relativt fort även flera veckor efter födelsen. Detta genom att ligga hud-mot-hud med modern under amningstillfällena. Hud-mot-hud kontakten mellan mamma och barn verkar ha en avslappnande effekt. Barnet börjar söka bröstet själv och reparerar på så sätt de störda amningsreflexerna.

Mammor läser ofta av personalens mer eller mindre tydliga åsikter, som även kan uttryckas med minspel och kroppsspråk. Mödrar agerar så som de tror att personalen förväntar sig.

Man kan överväga att föreslå mammor som haft mastit upprepade gånger att prova att äta SPC havre för att förebygga återkommande mastiter.

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## 9 REFERENCES

- Abou-Dakn M, Schäfer-Graf U, Wöckel A. Psychological stress and breast diseases during lactation. *Breastfeed Rev*. 2009;17:19-26.
- Abouelfettoh AM, Dowling DA, Dabash SA, Elguindy SR, Seoud IA. Cup versus bottle feeding for hospitalized late preterm infants in Egypt: a quasi-experimental study. *Int Breastfeed J*. 2008;21:27.
- Anisfeld E, Lipper E. Early contact, social support, and mother-infant bonding. *Pediatrics*. 1983;72(1):79-83.
- Armstrong WE, Hatton GI. The puzzle of pulsatile oxytocin secretion during lactation: some new pieces. *Am J Physiol Regul Integr Comp Physiol*. 2006;291(1):R26-8. Review.
- Arora S, McJunkin C, Wehrer J, Kuhn P. Major factors influencing breastfeeding rates: Mother's perception of father's attitude and milk supply. *Pediatrics*. 2000;106(5):E67.
- Battersby S. Understanding the social and cultural influences on breast-feeding today. *J Fam Health Care*. 2010;20(4):128-31.
- Baumgarder DJ, Muehl P, Fischer M, Pribbenow B. Effect of Labor Epidural Anesthesia on Breast-feeding of Healthy Full-term Newborns Delivered Vaginally. *J Am Board Fam Pract*. 2003;16:7-13.
- Bergman NJ, Linley LL, Fawcus SR. Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200- to 2199-gram newborns. *Acta Paediatr*. 2004;93(6):779-85.
- Björck S, Bosaeus I, Ek E, Jennische E, Lönnroth I, Johansson E, Lange S. Food-induced stimulation of the antisecretory factor improve recurrence from human colonic inflammatory disease. A study of a concept. *GUT*. 2000;46:824-829.
- Blair A, Cadwell K, Turner-Maffei C, Brimdyr K. The relationship between positioning, the breastfeeding dynamic, the latching process and pain in breastfeeding mothers with sore nipples. *Breastfeed Rev*. 2003;11(2):5-10
- Boccolini CS, de Carvalho ML, de Oliveira MI, Vasconcellos AG. Factors associated with breastfeeding in the first hour of life. *Rev Saude Publica*. 2011;45(1):69-78.
- Bramson L, Lee JW, Moore E, Montgomery S, Neish C, Bahjri K, Melcher CL. Effect of Early Skin-to-Skin Mother-Infant Contact During the First 3 Hours Following Birth on Exclusive Breastfeeding During the Maternity Hospital Stay. *Hum Lact*. 2010;26(2):130-137.
- Britton JR, Britton HL, Gronwaldt V. Breastfeeding, sensitivity, and attachment. *Pediatrics*. 2006;118(5):e1436-43.
- Britton JR, Britton HL. Maternal self-concept and breastfeeding. *J Hum Lact*. 2008;24(4):431-438.
- Burbach, J.P.H, Young, L. J., & Russell, J. A. (2006) Oxytocin: Synthesis, Secretion and Reproductive Functions. Knobil and Neill's Physiology of Reproduction. 3 3d. Elsevier.
- Bystrova K, Ivanova V, Edhborg M, Matthiesen AS, Ransjö-Arvidson AB, Mukhamedrakhimov R, Uvnäs-Moberg K, Widström AM. Early contact versus separation: effects on mother-infant interaction one year later. *Birth*. 2009;36:97-109.

- Bystrova K, Widström AM, Matthiesen AS, Ransjö-Arvidson AB, Welles-Nyström B, Vorontsov I, Uvnäs-Moberg K. Early lactation performance in primiparous and multiparous women in relation to different maternity home practices. A randomised trial in St. Petersburg. *Int Breastfeed J*. 2007;8:2:9.
- Bystrova K, Matthiesen AS, Widström AM, Ransjö-Arvidson AB, Welles-Nyström B, Vorontsov I, Uvnäs-Moberg K. The effect of Russian Maternity Home routines on breastfeeding and neonatal weight loss with special reference to swaddling. *Early Hum Dev*. 2007;83(1):29-39.
- Bystrova K, Widström AM, Matthiesen AS, Ransjö-Arvidson AB, Welles-Nyström B, Wassberg C, Vorontsov I, Uvnäs-Moberg K. Skin-to-skin contact may reduce negative consequences of "the stress of being born": a study on temperature in newborn infants, subjected to different ward routines in St. Petersburg. *Acta Paediatr*. 2003;92:320-326.
- Cadwell K. Latching-On and Suckling of the Healthy Term Neonate: Breastfeeding Assessment. American College of Nurse-Midwives. 2007;52(6):638-42.
- Carfoot S, Williamson P, Dickson R. A randomised controlled trial in the north of England examining the effects of skin-to-skin care on breast feeding. *Midwifery*. 2005; 21(1):71-9.
- Carlander AK, Edman G, Christensson K, Andolf E, Wiklund I. Contact between mother, child and partner and attitudes towards breastfeeding in relation to mode of delivery. *Sex Reprod Healthc*. 2010:27-34.
- Carvalhoes MA, Correa CR. Identification of difficulties at the beginning of breastfeeding by means of protocol application. *J Pediatr (Rio J)*. 2003;79(1):13-20.
- Chapman D J, Perez-Escamilla R. Lactogenesis stage II: hormonal regulation, determinants and public health consequences. *Recent Res. Dev. Nutr*. 2000;3:43–63.
- Chapman DJ, Pérez-Escamilla R. Identification of risk factors for delayed onset of lactation. *J Am Diet Assoc*. 1999;99(4):450-4.
- Chiu SH, Anderson GC, Burkhammer MD. Skin-to-skin contact for culturally diverse women having breastfeeding difficulties during early postpartum. *Breastfeed Med*. 2008. 3(4):231-7.
- Christensson K, Siles C, Moreno L, Belaustequi A, De La Fuente P, Lagercrantz H, Puyol P, Winberg J: Temperature, metabolic adaptation and crying in healthy full-term newborns cared for skin-to-skin or in a cot. *Acta Paediatr*. 1992;81(6-7):488-93.
- Conde-Agudelo A, Diaz-Rossello JL, Belizan JM. Kangaroo mother care to reduce morbidity and mortality in low birth weight infants. *Cochrane Database Syst Rev*. 2003;(2):CD002771.
- De Chateau P, Wiberg B. Long-term effect on mother-infant behaviour of extra contact during the first hour post partum. I. First observations at 36 hours. *Acta Paediatr Scand*. 1977;66(2):137-43.
- De Chateau P, Wiberg B. Long-term effect on mother-infant behaviour of extra contact during the first hour post partum. II. A follow-up at three months. *Acta Paediatr Scand*. 1977;66(2):145-51.
- De Vellis R. Scale Development Theory and Applications (Vol. Applied Social Research Methods Series. Volume 26). London: SAGE Publications. 2003.



- Dettwyler KA. Breastfeeding and weaning in Mali: cultural context and hard data. *Soc Sci Med.* 1987;24(8):633-44.
- Dewey KG, Nommsen-Rivers LA, Heinig MJ, Cohen RJ. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatric.* 2003;112:607-619.
- DiGirolamo AM, Grummer-Strawn LM, Fein SB. Effect of maternity-care practices on breastfeeding. *Pediatrics.* 2008;122:S2:S43–S49.
- DiGirolamo AM, Grummer-Strawn LM, Fein S. Maternity care practices: implications for breastfeeding. *Birth.* 2001;28:94-100.
- Donath SM, Amir LH. Maternal obesity and initiation and duration of breastfeeding: data from the longitudinal study of Australian children. *Matern Child Nutr.* 2008;4(3):163-70.
- Donnelly A, Snowden HM, Renfrew MJ, Woolridge MW. Commercial hospital discharge packs for breastfeeding women. *Cochrane Database Syst Rev.* 2000;(2):CD002075.
- Editorial, *The Lancet* 1994;17:344(8938:1702)
- Ekenstam, C. Historical ideas about the Body i Sweden from 1700-1950 (In Swedish). Thesis vid Göteborgs universitet, Gidlunds 1993.
- Ekström A, Widström AM, Nissen E. Duration of breastfeeding in Swedish primiparous and multiparous women. *J Hum Lact.* 2003a;19(2):172-8.
- Ekström A, Widström AM, Nissen E. Breastfeeding support from partners and grandmothers: perceptions of Swedish women. *Birth.* 2003b;0(4):261-6.
- Ekström A, Widström AM, Nissen E. Process oriented training in breastfeeding alters attitudes to breastfeeding in health professionals. *Scand J Public Health.* 2005;38:424-438.
- Ekström A, Nissen E. A mother's feelings for her infant are strengthened by excellent breastfeeding counseling and continuity of care. *Pediatrics.* 2006;118(2):e309-14.
- Epstein K. The interactions between breastfeeding mothers and their babies during the breastfeeding session. *Early Child Development and Care.* 1990;87:93-104.
- Eriksson A, Shafazand M, Jennische E, Lange S. Effect of Antisecretory Factor in Ulcerative Colitis on Histological and Laborative outcome: aa Short Period clonical trial. *Scand. J. Gastroenterol.* 2003;10:1046-1049.
- Eriksson A, Jennische E, Shafazand M, Lange S, Lönnroth I. Antisecretory Factor induced regression of Crohn's disease in a weak responder to conventional pharmacological treatment. *Inflammatory Bowel Diseases.* 2003;9(6):398-400.
- Erlandsson K, Christensson, Dsilna A, Jonsson B. Do caregiving models after Cesarean birth influence the infants breath adoption? *Journal of Children's and Young People's Nursing* January. 2008;02:(01):7-12.
- Erlandsson K, Dsilna A, Fagerberg I, Christensson K. Skin-to-skin care with the father after Cesarean birth and its effect on newborn crying and prefeeding behavior. *Birth.* 2007;34(2):105-14.
- Evans KC, Evans RG, Royal R, Esterman AJ, James SL. Effect of caesarean section on breast milk transfer to the normal term newborn over the first week of life. *Arch Dis Child Fetal Neonatal Ed.* 2003;88(5):F380-2.

- Fairbank L, O'Meare S, Renfrew MJ, Woolridge M, Snowden AJ, Lister-Sharp D. A systematic review to evaluate the effectiveness of interventions to promote the initiation of breastfeeding. *Health Technology Assessment: HTA / NHS R&D HTA Programme* 2000;4:1-171.
- Feldman R, Weller A, Zagoory-Sharon O and Levine A. Evidence for a neuroendocrinological foundation of human affiliation: plasma oxytocin levels across pregnancy and the postpartum period predict mother-infant bonding. *Psychol Sci.* 2007;18:965-70.
- Fetherstone C. Mastitis in lactating women: physiology or pathology? *Breastfeeding Review.* 2001;9:5-12.
- Flacking R, Dykes F, Ewald U. The influence of fathers' socioeconomic status and paternity leave on breastfeeding duration: a population-based cohort study. *Scand J Public Health.* 2010; 38(4):337-43. Epub 2010 Feb 10.
- Flacking R, Nyqvist KH, Ewald U. Effects of socioeconomic status on breastfeeding duration in mothers of preterm and term infants. *Eur J Public Health.* 2007;17(6):579-84.
- Flores-Quijano ME, Córdova A, Contreras-Ramírez V, Farias-Hernández L, Cruz Tolentino M, Casanueva E. Risk for postpartum depression, breastfeeding practices, and mammary gland permeability. *J Hum Lact.* 2008;24(1):50-7.
- Folkhälsoinstitutet. Breastfeeding today (In Swedish). Förlagshuset Gothia. 1998
- Forster DA, McLachlan HL. Breastfeeding initiation and birth setting practices: a review of the literature. *J Midwifery Womens Health.* 2007;52(3):273-280.
- Foxman B, D'Arcy H, Gillespie B, Bobo JK, Schwartz K. Lactation mastitis: occurrence and medical management among 946 breastfeeding women in the United States. *Am J Epidemiol.* 2002;155(2):103-14.
- Gagnon AJ, Leduc G, Waghorn K, Yang H, Platt RW. In-hospital formula supplementation of healthy breastfeeding newborns. *J Hum Lact.* 2005;21:397-405.
- Geddes DT. The use of ultrasound to identify milk ejection in women - tips and pitfalls. *Int Breastfeed J.* 2009;1:4:5.
- Gitau R, Modi N, Gianakouloupoulos X, Bond C, Clover V. Acute effects of maternal skin-to-skin contact and massage on saliva cortisol in preterm babies. *Journals of Reproductive and Infant Psychology.* 2002;20(2):83-88
- Gouchon S, Gregori D, Picotto A, Patrucco G, Nangeroni M, Di Giulio P. Skin-to-skin contact after Cesarean delivery: an experimental study. *Nurs Res.* 2010;59(2):78-84.
- Gourch RL. Factor Analysis, Second edition New Jersey & London: Lawrence Erlbaum Associates Publishers, 1983.
- Gustafsson A, Widström A-M: Support and guidance during breastfeeding - A description and comparison of two midwives ways of communicate. Master thesis. Department of Women's and Children's Health Division of Reproductive and Perinatal Health Karolinska Institutet 2006.
- Göransson L, Lange S, Lönnroth I. Post weaning diarrhoea: focus on diet. *Pigs News and Information.* 1995;16:3:89N-91N.
- Hamosh M. Digestion in the newborn. *Clin Perinatol.* 1996;23(2):191-209.

- Handlin L. Human-Human and Human-Animal. Interaction. Some Common Physiological and Psychological Effects. Faculty of Veterinary Medicine and Animal Science Department of Animal Environment and Health, Skara. Phd thesis. Swedish University of Agricultural sciences.2010:98
- Hanner P, Jennische E, Lange S, Lönnroth I, Wahlström, B. Increased antiseactory factor reduces vertigo in patients with Menière's Disease: a pilot study. *Hearing Research* 2004;4803:1-6.
- Hanner P, Rask-Andersen H, Lange S, Jennische E. Antiseactory Factor inducing therapy improves the clinical outcome in patients with Menière's disease. *Acta Laryng.* 2009;28:1-5.
- Hanson LÅ. Immunobiology of Human Milk: How Breastfeeding Protects Babies. Publishing Pharmasoft. 2005. Online Web Orders. [www.breastfeeding.com]
- Healthy Children project 2010. DVD "Skin to Skin the First Hour After Birth: Practical Advice for Staff after Vaginal and Cesarean Birth". www.healthychildren.cc
- Henderson C, Macdonald S. Mayes' Midwifery: A textbook for Midwives. Publisher: Bailliere Tindall 2004.
- Hillervik-Lindquist C. Studies on perceived breast milk insufficiency. A prospective study in a group of Swedish women. *Acta Paediatr Scand Suppl.* 1991;376:1-27.
- Howard CR, Howard FM, Lanphear B, Eberly S, deBlieck EA, Oakes D, Lawrence RA. Randomized clinical trial of pacifier use and bottle-feeding or cup feeding and their effect on breastfeeding. *Pediatrics.* 2007;111:511-8.
- Huang YY, Gau ML, Huang CM, Lee JT. Supplementation with cup-feeding as a substitute for bottle-feeding to promote breastfeeding. *Chang Gung Med J.* 2009;32:423-31.
- Häggkvist AP, Brantsæter AL, Grjibovski AM, Helsing E, Meltzer HM, Haugen M. Prevalence of breast-feeding in the Norwegian Mother and Child Cohort Study and health service-related correlates of cessation of full breast-feeding. *Public Health Nutr.* 2010;13(12):2076-86.
- Hörnell A, Aarts C, Kylberg C, Hofvander Y, Gebre-Medhin M. Breastfeeding patterns in exclusively breastfed infants: a longitudinal prospective study in Uppsala, Sweden *Acta Paediatr* 88: 203-211. 1999.
- Hörnell A, Hofvander Y, Kylberg E: Solid and formula: Association with pattern and duration of breastfeeding. *Pediatrics.* 2001;107(3):E38.
- Ip S, Chung M, Raman G, Trikalinos TA, Lau J. A summary of the Agency for Healthcare Research and Quality's evidence report on breastfeeding in developed countries. *Breastfeed Med.*2009;1:17-30.
- Johansson E, Lönnroth I, Jonson I, Lange S, Jennische E. Development of monoclonal antibodies for detection of antiseactory factor activity in human plasma. *J Immunol Methods.*2009;15;342(1-2):64-70. Epub 2008 Dec 25.
- Johansson E, Jennische E, Lange S, Lönnroth I. Antiseactory factor supresses intestinal inflammation and hypersecretion. *Gut.* 1997;41:642-645.
- Johansson E, Lönnroth I, Lange S, Jonson I, Jennische E, Lönnroth C. Molecular cloning and expression of a pituitary gland protein modulating intestinal fluid secretion. *J. Biol. Chem.* 1995;270:35:1:20615-20620.

- Jonas K, Johansson LM, Nissen E, Ejdebäck M, Ransjö-Arvidson AB, Uvnäs-Moberg K. Effects of intrapartum oxytocin administration and epidural analgesia on the concentration of plasma oxytocin and prolactin, in response to suckling during the second day postpartum. *Breastfeed Med*. 2009;4(2):71-82.
- Jonas W, Nissen E, Ransjö-Arvidson AB, Matthiesen AS, Uvnäs-Moberg K. Influence of oxytocin or epidural analgesia on personality profile in breastfeeding women: a comparative study. *Arch Womens Ment Health*. 2008;11(5-6):335-45.
- Johnston JM, Amico JA. A prospective longitudinal study of the release of oxytocin and prolactin in response to infant suckling in long term lactation. *J Clin Endocrinol Metab*. 1986;62(4):653-7.
- Jundell I. *The Healthy and the Sick Child* (In Swedish). Bonniers 1927.
- Karlström A, Engström-Olofsson R, Norbergh K-G, Sjöling M, Hildingsson I. Postoperative pain after Cesarean birth affects breastfeeding and infant care. *Journal of Obstetric, Gynecologic and Neonatal Nursing*. 2007;36(5):430-40.
- Keith KA. Infant feeding choice among first-time mothers. *Sch Inq Nurs Pract*. 1997;11(3):199-224.
- Keefe MR. The impact of infant rooming-in on maternal sleep at night. *J Obstet Gynecol Neonatal Nurs* 1988;17:122–126. 7. Keefe MR. Comparison of neonatal nighttime sleep-wake patterns in nursery versus rooming-in environments. *Nurs Res*. 1987;36:140–144.
- Keefe MR. Comparison of neonatal nighttime sleep-wake patterns in nursery versus rooming-in environments. *Obstet Gynecol Neonatal Nurs*. 1988;17(2):122-6.
- Kennell JH, Klaus PH. *Bonding. Building the foundation of secure attachment and independency*. New York: Addison-Wesley, 1995.
- Kennell JH, Jerauld R, Wolfe H, Chesler D, Kreger NC, McAlpine W, Steffa M, Klaus MH. Maternal behavior one year after early and extended post-partum contact. *Dev Med Child Neurol*. 1974;16(2):172-9.
- Kinlay JR, O'Connell DL, Kinlay S. Risk factors for mastitis in breastfeeding women: results of a prospective cohort study. *Aust N Z J Public Health*. 2001;25(2):115-20.
- Klaus MH, Jerauld R, Kreger NC, McAlpine W, Steffa M, Kennel JH. Maternal attachment. Importance of the first post-partum days. *N Engl J Med*. 1972;286(9):460-3.
- Klaus M, Kennell J. Parent to infant bonding: setting the record straight. *J Pediatr*. 1983; 102(4):575-6.
- Khoso M. No nursing mother. Women's experience of breastfeeding difficulties that lead to discontinued breastfeeding (In Swedish). Institutionen för psykologi, Lunds universitet, vol II, nr 15, 2000.
- Kristiansen AL, Lande B, Overby NC, Andersen LF. Factors associated with exclusive breast-feeding and breast-feeding in Norway. *Public Health Nutr*. 2010;16:1-10.
- Kronborg H, Vaeth N. The influence of psychosocial factors on the duration of breastfeeding. *Scand J Public Health*. 2004;32(3):210-6
- Kull I, Melen E, Alm J, Hallberg, Svartengren M, van Hage M, Pershagen G, Wickman M, Bergström A. Breastfeeding in relation to asthma, lung function and sensitization in young school children. *J Allergy Clin Immunol*. 2010;125(5):1013-9.

- Kvist LJ, Larsson BW, Hall-Lord ML, Steen A, Schalén C. The role of bacteria in lactational mastitis and some considerations of the use of antibiotic treatment. *Int Breastfeed J*. 2008;7:3:6.
- Kvist LJ. Toward a clarification of the concept of mastitis as used in empirical studies of breast inflammation during lactation. *J Hum Lact*. 2010;26(1):53-9. Review.
- Köheler L. Indicators of child health in Sweden (In Swedish) Save the Children 2004.
- Laantera S, Pölkki T, Pietilä AM. A descriptive qualitative review of the barriers relating to breast-feeding counselling. *Int J Nurs Pract*. 2011;17(1):72-84. doi: 10.1111/j.1440-172X.2010.01909.x.
- Lamontagne C, Hamelin AM, St-Pierre M. The breastfeeding experience of women with major difficulties who use the services of a breastfeeding clinic: a descriptive study. *Int Breastfeed J*. 2008;5:17.
- Lange S and Lönnroth I. The Antisecretory Factor: Synthesis, anatomical and Cellular Distribution and Biological Action in Experimental and Clinical Studies. *International Review of Cytology*. 2001;210:39-75
- Lange S, Jennische E, Johansson E, Lönnroth I. The antisecretory factor - synthesis and intracellular localisation in porcine tissues. *Cell and tissue research*. 1999;296:607-617.
- Larsen JS, Hall EO, Aagaard H. Shattered expectations: when mothers' confidence in breastfeeding is undermined--a metasynthesis. *Scand J Caring Sci*. 2008;22(4):653-61.
- Laurenius A, Wängberg B, Lange S, Jennische E, Lundgren BK, Bosaeus I. Antisecretory factor counteracts secretory diarrhoea of endocrine origin. *Clinical Nutrition*. 2003;22(6):549-552.
- Lavelli M, Poli M. Early mother – infant interaction during breast- and bottle feeding. *Infant Behavior and Development*. 1998;21(4):667-684.
- Lavender T, Hofmeyr GJ, Neilson JP, Kingdon C, Gyte GM. Caesarean section for non-medical reasons at term. *Cochrane Database Syst Rev*. 2006;19:3:CD004660.
- Leng G, Meddle SL, Douglas AJ. Oxytocin and the maternal brain. *Curr Opin Pharmacol*. 2008;8:731-4. Review.
- Levine A, Zagoory-Sharon O, Feldman R, Weller A. Oxytocin during pregnancy and early postpartum: individual patterns and maternal-fetal attachment. *Peptides*. 2007;28: 1162-9.
- Li J, Kendall GE, Henderson S, Downie J, Landsborough L, Oddy WH. Maternal psychosocial well-being in pregnancy and breastfeeding duration. *Acta Paediatr*. 2008;97(2):221-5.
- Lincoln DW, Paisley AC. Neuroendocrine control of milk ejection. *J Reprod Fertil*. 1982;65(2):571-86. Review.
- Ludvigsson JF, Ludvigsson J. Socio-economic determinants, maternal smoking and coffee consumption, and exclusive breastfeeding in 10205 children. *Acta Paediatr*. 2005;94(9):1310-9.
- Ludwig M, Leng G. Dendritic peptide release and peptide-dependent behaviours. *Nat Rev Neurosci*. 2006;7:126-36.
- Lundeberg T, Uvnäs-Moberg K, Agren G, Bruzelius G. Anti-nociceptive effects of oxytocin in rats and mice. *Neurosci Lett*. 1994;8:170(1):153-7.

- Lundin C. Urban Swedish women's symptoms and treatment for mastitis (In Swedish). Institutionen för kvinnor och barns häls. Enheten för reproduktiv och perinatal omvårdnad. Karolinska Institutet, Examensarbete på D-nivå (61-80p) Höstterminen 2005.
- Lönnroth I, Lange S, Jennische E, Johansson E, Jonson I, Torres J. Cholera toxin protects against action by clostridium difficile toxin A. The role of antisecretory factor in intestinal secretion and inflammation in rat. *APMIS*. 2003;111:969-977.
- Makhlouf Obermeyer C, Castle S. Back to Nature? Historical and Cross-cultural Perspectives on Barriers to Optimal Breastfeeding. *Medical Anthropology*. 1997;17:39-63.
- Mann PE, Bridges RS. Lactogenic hormone regulation of maternal behavior. *Prog Brain Res*. 2001;133:251-62.
- Marín Gabriel MA, Llana Martín I, López Escobar A, Fernández Villalba E, Romero Blanco I, Touza Pol P. Randomized controlled trial of early skin-to-skin contact: effects on the mother and the newborn. *Acta Paediatr*. 2010;99(11):1630-4. doi: 10.1111/j.1651-2227.2009.01597.x.
- Matthiesen AS, Ransjö-Arvidson AB, Nissen E, Uvnäs-Moberg K. Postpartum maternal oxytocin release by newborns: effects of infant hand massage and sucking. *Birth*. 2001;28:13-9.
- Mead M. and Newton N. Cultural patterning of prenatal behavior. In S Richardson and A Guttmacher (eds.), *Childbearing - its Social and Psychological Aspects*. Baltimore: Williams and Wilkins 1967. Page 180-182.
- Merewood A, Philipp BL. Becoming Baby-Friendly: Overcoming the issue of accepting free formula. *J Hum Lact*. 2000;16:272-282.
- Mizuno K, Mizuno N, Shinohara T, Noda M. Mother–infant skin-to-skin contact after delivery results in early recognition of own mother’s milk odour. *Acta Paediatr*. 2004;93(12):1640-1645
- Moore ER, Anderson GC, Bergman N. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database Syst Rev*. 2007;18:(3):CD003519
- Morrison B, Ludington-Hoe S, Anderson GC. Interruptions to breastfeeding dyads on postpartum day 1 in a university hospital. *J Obstet Gynecol Neonatal Nurs*. 2006;35(6):709-16.
- National Board of Health and Welfare 2010 Official Statistics of Sweden, Statistics – Health and Medical Care Breast-feeding and smoking habits among parents of infants born in 2008 (In Swedish, Summary in English)
- Nelson, J. An essay on government of children under three general heads: viz, health, manner and education. Anonymous An essay on Government of Children under three general heads. London. 1753
- Neville MC, Morton J. Physiology and endocrine changes underlying human lactogenesis II. *J Nutr*. 2001;131(11):3005S-8S. Review.
- Newton M, Newton NR. The let-down reflex in human lactation. *J Pediatr*. 1948;33(6):698-704.
- Nissen E, Lilja G, Widström AM, Uvnäs-Moberg K. Elevation of oxytocin levels early post partum in women. *Acta Obstet Gynecol Scand*. 1995;74(7):530-3.

- Nissen E, Gustavsson P, Widström AM, Uvnäs-Moberg K. Oxytocin, prolactin, milk production and their relationship with personality traits in women after vaginal delivery or Cesarean section. *J Psychosom Obstet Gynaecol*. 1998;19(1):49-58.
- Nyqvist KH, Anderson GC, Bergman N, Cattaneo A, Charpak N, Davanzo R, Ewald U, Ludington-Hoe S, Mendoza S, Pallás-Allonso C, Peláez JG, Sizun J, Widström AM. Kangaroo Mother Care: application in a high-tech environment. State of the art and Recommendations. *Acta Paediatr*. 2010;99(6):812-9.
- Nysaether H, Baerug A, Nylander G, et al. Rooming-in in the maternity ward—are mothers satisfied? *Nor Laegeforen*. 2002;122:1206–1209.
- Ohrlander K. In the interest of the child and the nation. The politics of social liberal reform, 1903-1930 (In Swedish).1992. Thesis . Högskolan för lärarutbildning i Stockholm, institutionen för pedagogik. Stockholm: Almqvist och Wicksell
- Pérez-Ríos N, Ramos-Valencia G, Ortiz AP. Cesarean delivery as a barrier for breastfeeding initiation: the Puerto Rican experience. *J Hum Lact*. 2008;24(3):293-302.
- Peterson AE, Pérez-Escamilla R, Labbok MH, Hight V, von Hertzen H, Van Look P. Multicenter study of the lactational amenorrhea method (LAM) III: effectiveness, duration, and satisfaction with reduced client-provider contact. *Contraception*. 2000 Nov;62(5):221-30.
- Primary Child Health Care Annual Report. (In Swedish)  
[www.webbhotell.sll.se/Global/Bhv/Dokument/Rapporter/BHV\\_SLL\\_2009\\_VB.pdf](http://www.webbhotell.sll.se/Global/Bhv/Dokument/Rapporter/BHV_SLL_2009_VB.pdf)
- Prime DK, Geddes DT, Spatz DL, Robert M, Trengove NJ, Hartmann PE. Using milk flow rate to investigate milk ejection in the left and right breasts during simultaneous breast expression in women. *Int Breastfeed J*. 2009;26:4:10.
- Ransjö-Arvidson AB, Matthiesen AS, Lilja G, Nissen E, Widström AM, Uvnäs-Moberg K. Maternal analgesia during labor disturbs newborn behavior: effects on breastfeeding, temperature, and crying. *Birth*. 2001;28:5-12.
- Rasmussen KM, Kjolhede CL. Prepregnant overweight and obesity diminish the prolactin response to suckling in the first week postpartum. *Pediatrics*. 2004;113(5):e465-71.
- Righard L, Alade MO. Effect of delivery room routines on success of first breast-feed. *Lancet* 1990, 336:1105-7.
- Rosen IM, Krueger MV, Carney LM, Graham JA. Prenatal breastfeeding education and breastfeeding outcomes. *MCN Am J Matern Child Nurs*. 2008;33(5):315-9.
- Rowe-Murray HJ, Fisher JR. Baby friendly hospital practices: Cesarean section is a persistent barrier to early initiation of breastfeeding. *Birth*. 2002 Jun;29(2):124-31.
- Rowe-Murray HJ, Fisher JR. Operative intervention in delivery is associated with compromised early mother-infant interaction. *BJOG*. 2001;108(10):1068-75.
- Sachdev HPS. "Kangaroo mother care" method to reduce morbidity and mortality in low-birth-weight infants: RHL commentary (last revised: 2 June 2003). The WHO Reproductive Health Library. Geneva: World Health Organization.
- Samson WK, Lumpkin MD, McCann SM. Evidence for a physiological role for oxytocin in the control of prolactin secretion. *Endocrinology*. 1986. 119(2):554-60.

- Salariya EM, Easton PM, Cater JI. Duration of breast-feeding after early initiation and frequent feeding. *Lancet*. 1978;25:2(8100):1141-3.
- Schwartz K, D'Arcy HJ, Gillespie B, Bobo J, Longeway M, Foxman B. Factors associated with weaning in the first 3 months postpartum. *J Fam Pract*. 2002;51(5):439-44.
- Scott JA, Binns CW, Oddy WH, Graham KI. Predictors of breastfeeding duration: evidence from a cohort study. *Pediatrics*. 2006;117(4):e646-55.
- Shepherd CK, Power KG, Carter H. Examining the correspondence of breastfeeding and bottle-feeding couples' infant feeding attitudes. *J Adv Nurs*. 2000;31(3):651-60.
- Semenic S, Loiselle C, Gottlieb L. Predictors of the duration of exclusive breastfeeding among first-time mothers. *Res Nurs Health* 2008;31(5):428-441.
- Sosial- og helsedirektoratet, Norge. Nutrition for six month old babies (In Norwegian). 2008. [www.shdir.no](http://www.shdir.no)  
[www.helsedirektoratet.no/vp/multimedia/archive/00054/IS-1535\\_54649a.pdf](http://www.helsedirektoratet.no/vp/multimedia/archive/00054/IS-1535_54649a.pdf)
- Socialstyrelsen New recommendation. Only breast milk until six months of age (In Swedish). . [www.sos.se/FULLTEXT/126/2003-126-16/2003-126-16.htm](http://www.sos.se/FULLTEXT/126/2003-126-16/2003-126-16.htm)
- SOU 1993:86. Protecting, promoting and supporting breastfeeding: the special role of maternity services (In Swedish) Stockholm: Fritzes Förlag
- Stjernholm YV, Petersson K, Eneroth E. Changed indications for Cesarean sections. *Acta Obstet Gynecol Scand*. 2010;89(1):49-53.
- Svensson K, Nordgren M. Amningsboken. (English title: The Breastfeeding book). Natur och Kultur, Stockholm 2005.
- Taveras EM, Capra AM, Braveman PA, Jensvold NG, Escobar GJ, Lieu TA. Clinician support and psychosocial risk factors associated with breastfeeding discontinuation. *Pediatrics*. 2003;112:(1 Pt 1):108-15.
- Tham V, Christensson K, Ryding EL. Sense of coherence and symptoms of post-traumatic stress after emergency caesarean section. *Acta Obstet Gynecol Scand*. 2007;86(9):1090-6.
- Theodosia DT. Oxytocin-secreting neurons: A physiological model of morphological neuronal and glial plasticity in the adult hypothalamus. *Front Neuroendocrinol*. 2002;23(1):101-35.
- Theodosia DT, Trailin A, Poulain DA. Remodeling of astrocytes, a prerequisite for synapse turnover in the adult brain? Insights from the oxytocin system of the hypothalamus. *Am J Physiol Regul Integr Comp Physiol*. 2006;290(5):R1175-82.
- Thulier D, Mercer J: Variables associated with breastfeeding duration. *J Obstet Gynecol Neonatal Nurs*. 2009;38(3):259-68.
- Torvaldsen S, Roberts CL, Simpson JM, Thompson JF, Ellwood DA. Intrapartum epidural analgesia and breastfeeding: a prospective cohort study. *Int Breastfeed J*. 2006; 11:1-24.
- Toshihiro U, Yuji Y, Minoru I, Toshihiro A. Influence of Psychological stress on Suckling-Induced Pulsatile Oxytocin Release. *Obstetrics & Gynecology*.1994;24(2)259-262.
- Uvnäs-Moberg K, Bruzelius G, Alster P, Bileviciute I, Lundeberg T. Oxytocin increases and a specific oxytocin antagonist decreases pain threshold in male rats. *Acta Physiol Scand*. 1992;144(4):487-8.



- Uvnäs-Moberg K, Widström A-M, Nissen E, Björvell H. Personality traits in women 4 days postpartum and their correlation with plasma levels of oxytocin and prolactin. *J Psychosom Obstet Gynecol*. 1990a;11:261-273.
- Uvnäs-Moberg K, Widström AM, Werner S, Matthiesen AS, Winberg J. Oxytocin and prolactin levels in breast-feeding women. Correlation with milk yield and duration of breast-feeding. *Acta Obstet Gynecol Scand*, 1990b :69:301-6.
- van Esterik, P. The Insufficient Milk Syndrome: Biological Epidemic or Cultural Konstruktion? In : P. Whelehan & Contributors (Eds.), *Women & Health Cross Cultural Perspectives* (pp. 97-109). New York: Bergin & Garvey. 1988.
- Velandia M, Matthiesen AS, Uvnäs-Moberg K, Nissen E. Onset of vocal interaction between parents and newborns in skin-to-skin contact immediately after elective Cesarean section. *Birth*. 2010;37(3):192-201.
- Vuorenkoski V, Wasz-Höckert O, Koivisto E, Lind J. The effect of cry stimulus on the temperature of the lactating breast of primipara. A thermographic study. *Experientia*. 1969;15;25(12):1286-7.
- Waldenström U, Swenson A. Rooming-in at night in the postpartum ward. *Midwifery*. 1991;7:82–89.21.
- Welles-Nyström, B.. “Co-sleeping as a window into Swedish culture: Considerations of gender and health.” *Scandinavian Journal of Caring Sciences*. 2005;19:4:354-360.
- Wiberg B, Humble K, de Château P. Long-term effect on mother-infant behaviour of extra contact during the first hour post partum. V. Follow-up at three years. *Scand J Soc Med*. 1989;17(2):181-91.
- Widström AM, Lilja G, Aaltomaa-Michalias P, Dahllöf A, Lintula M, Nissen E. Newborn behaviour to locate the breast when skin-to-skin: a possible method for enabling early self-regulation. *Acta Paediatr*. 2011;100(1):79-85. doi: 10.1111/j.1651-2227.2010.01983.x.
- Widström AM, Ransjö-Arvidson AB, Christensson K, Matthiesen AS, Winberg J, Uvnäs-Moberg K. Gastric suction in healthy newborn infants. Effects on circulation and developing feeding behaviour. *Acta Paediatr Scand*. 1987;76:566-572.
- Widström AM, Wahlberg V, Matthiesen AS, Eneroth P, Uvnäs-Moberg K, Werner S, Winberg J. Short-term effects of early suckling and touch of the nipple on maternal behaviour. *Early Hum Dev*. 1990;21(3):153-63.
- Widström AM, Thingström-Paulsson J. The position of the tongue during rooting reflexes elicited in newborn infants before the first suckle. *Acta Paediatr*. 1993;82:281-3.
- Wiesenfeld AR, Malatesta CZ, Whitman PB, Granrose C, Uili R. Psychophysiological response of breast- and bottle-feeding mothers to their infants' signals. *Psychophysiology*. 1985;22(1):79-86.
- Wiklund I, Norman M, Uvnäs-Moberg K, Ransjö-Arvidson AB, Andolf E. Epidural analgesia: breast-feeding success and related factors. *Midwifery*. 2009;25:31-8.
- Winikoff B, Laukaran VH, Myers D, Stone R: Dynamics of infant feeding: mothers, professionals, and the institutional context in a large urban hospital. *Pediatrics*. 1986; 77:357-65.

- Witte W, Jorsal SE, Roth FX, Kirchgesser M, Göransson L, Lange S, Pedersen KB. Future strategies with regard to the use of feed without antibiotic additives in pig production. *Pig News and Information*. 2000;21(1)27N-32N.
- World Health Organizatio. Baby-Friendly Hospital Initiative, revised, updated and expanded for integrated care. 2009.  
[http://whqlibdoc.who.int/publications/2009/9789241594967\\_eng.pdf](http://whqlibdoc.who.int/publications/2009/9789241594967_eng.pdf)
- World Health Organization, W. Mastitis Causes and management. In: Inch,S., von Xylander,S., Savage,F. (Eds.) Department of child and Adolescent Health and Development, Mastitis Causes and management. WHO, Geneva. 2000.
- World Health Organization, W. Protecting, promoting and supporting breastfeeding: the special role of maternity services - A joint WHO/UNICEF Statement. WHO, Geneva. 1989.
- World Health Organization, W. WHO Internationell Code of Marketing of Breast-milk subsubstitutes. WHO Internationell Code of Marketing of Breast-milk subsubstitutes. WHO, Geneva. 1981.
- Wöckel A, Beggel A, Rütke M, Abou-Dakn M, Arck P. Predictors of inflammatory breast diseases during lactation--results of a cohort study. *Am J Reprod Immunol*. 2010;63:(1):28-37.
- Yström E, Niegel S, Klepp KI, Vollrath ME. Impact of Maternal Negative Affectivity and General Self-Efficacy on Breastfeeding: The Norwegian Mother and Child Cohort Study. *Journal of Pediatric*. 2008;68-72.
- Zaman S, Mannan J, Lange S, Lönnroth, I, Hanson LÅ. Efficacy of B 221, a medical food containing antisecretory factors in reducing diarrheal illnesses in children 6-24 months of age - a placebo controlled trial *Acta Paediatrica*. 2007;96:1655-1659.
- Zwedberg S. I Wanted to Breastfeed! A Hermeneutical Study of Mothers with Breastfeeding Problems; Their Experiences and Coping Strategies, and Consultative Meetings with Midwives. Phd thesis. Pedagogiska institutionen, Stockholms universitet. Printed in Sweden by E-print, Stockholm, Sweden 2010.